UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
TEXARKANA DIVISION

MIMO RESEARCH, LLC, ***Plaintiff,*** v. **SAMSUNG ELECTRONICS AMERICA, INC. AND SAMSUNG ELECTRONICS CO., LTD.,** ***Defendants.***	**Civil Action No._____** **JURY TRIAL DEMANDED**

COMPLAINT FOR PATENT INFRINGEMENT

MIMO Research, LLC ("MIMO Research" or "Plaintiff") brings this action and makes the following allegations of patent infringement relating to U.S. Patent Nos.: 7,091,854 (the "'854 patent"); 7,046,716 (the "'716 patent"); 7,133,646 (the "'646 patent"); 7,305,057 (the "'057 patent"); and 7,433,382 (the "'382 patent") (collectively, the "patents-in-suit"). Defendants Samsung Electronics America, Inc. and Samsung Electronics Co., Ltd. (collectively, "Defendant(s)" or "Samsung") infringe the patents-in-suit in violation of the patent laws of the United States of America, 35 U.S.C. § 1 *et seq*.

THE PARTIES

1. Plaintiff MIMO Research, LLC ("Plaintiff" or "MIMO Research") is a New York limited liability company established in 2017. MIMO Research owns a portfolio of patents that cover Multiple Input Multiple Output ("MIMO") wireless communication, powerline networking, and ultra-wideband ("UWB") technology. MIMO Research is the owner of all rights, title, and interest in and to the patents-in-suit.

2. Highlighting the importance of the patents-in-suit is the fact that the MIMO Research patent portfolio has been cited by over 800 U.S. and international patents and patent

applications assigned to a wide variety of the largest companies operating in the wireless integrated circuit field. MIMO Research's patents have been cited by companies such as:

- Apple Inc.[1]
- Broadcom Inc.[2]
- STMicroelectronics N.V. [3]
- Sony Group Corporation[4]
- Nokia Corporation[5]
- Qualcomm, Inc.[6]
- Siemens AG[7]
- Fujitsu Limited[8]

3. Samsung has cited the MIMO Research patents in 22 patents and patent applications, including: U.S. Patent Nos. 7,305,250; 7,392,012; 7,929,995; 7,969,859; 8,478,271; 8,611,465; 9,002,304; 9,306,616; and 7,483,406, and U.S. Patent Application Nos. 2004/0259594; 2005/0170802; 2005/0195883; 2005/0243756; 2006/0209755; 2007/0140319; 2007/0195860; 2008/0076433; 2008/0189119; 2009/0175381; 2012/0243645; 2014/0065992; and 20150180532.

4. Defendant Samsung Electronics America, Inc. is a corporation organized under the laws of the State of New York with its principal place of business at 85 Challenger Road, Ridgefield Park, New Jersey 07660. Samsung Electronics America, Inc. may be served by serving

[1] *See, e.g.*, U.S. Patent Nos. 7,548,577; 8,279,913; 8,705,641; 8,743,852; 8,958,760; 9,490,864; and 9,614,578.

[2] *See, e.g.*, U.S. Patent Nos. 7,885,323; 8,520,715; 7,680,083; 7,725,096; 7,795,973; 7,808,985; 7,860,146; 7,873,324; 7,877,078; 7,899,436; 7,956,689; 8,160,127; 8,213,895; 8,406,239; 8,437,387; 8,509,707; 8,750,362; 8,750,392; 8,885,814; 9,042,436; 9,065,465; 9,313,828; and 9,936,439.

[3] *See, e.g.*, U.S. Patent Nos. 7,660,342; 7,656,932; 7,660,341; 7,817,763; and 8,817,935.

[4] *See, e.g.*, U.S. Patent Nos. 9,265,004; 7,542,728; 7,545,787; 7,567,820; 7,688,784; 7,822,436; 7,881,252; 8,045,447; 8,121,144; 8,160,001; 8,259,823; 8,462,746; 9,036,569; 9,237,572; 9,258,833; 8,660,196; and 9,276,649.

[5] *See, e.g.*, U.S. Patent Nos. 7,499,674; 7,643,811; 7,697,893; 7,782,894; and 9,913,248.

[6] *See, e.g.*, U.S. Patent Nos. 8,767,812; 9,300,491; 7,916,081; 8,009,775; 8,054,223; 8,401,503; 8,452,294; 8,467,331; 8,472,551; 8,743,903; 8,745,137; 8,745,695; 8,774,334; and 8,824,477.

[7] *See, e.g.*, U.S. Patent Nos. 7,378,980; 7,382,271; 7,408,839; 8,155,664; and 10,051465.

[8] *See, e.g.*, U.S. Patent Nos. 7,702,022; 7,995,680; 8,761,275; and 8,938,017.

its registered agent CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201-3136.

5. Samsung Electronics America, Inc. is a wholly-owned subsidiary of Samsung Electronics Co. Ltd. Samsung Electronics America, Inc. and Samsung Electronics Co. Ltd. are collectively referred to herein as "Samsung."

6. Defendant Samsung Electronics Co. Ltd. is a corporation organized under the laws of Korea, with its principal place of business located at 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonngi-do 443-742, Republic of Korea.

7. Samsung conducts business operations within the Eastern District of Texas in its facilities and stores located at: 776 Henrietta Creek Rd 55 Roanoke, Texas 76262-6398; 6625 Excellence Way, Plano, Texas 75023; and 2601 Preston Road, Frisco, Texas 75034.

JURISDICTION AND VENUE

8. This action arises under the patent laws of the United States, Title 35 of the United States Code. Accordingly, this Court has exclusive subject matter jurisdiction over this action under 28 U.S.C. §§ 1331 and 1338(a).

9. This Court has personal jurisdiction over Samsung in this action because Samsung has committed acts within the Eastern District of Texas giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over Samsung would not offend traditional notions of fair play and substantial justice. Defendant Samsung, directly and/or through subsidiaries or intermediaries (including distributors, retailers, and others), has committed and continues to commit acts of infringement in this District by, among other things, offering to sell and selling products and/or services that infringe the patents-in-suit. Moreover, Samsung is registered to do business in the State of Texas, has offices and facilities in the State of Texas, and actively directs its activities to customers located in the State of Texas.

10. Venue is proper in this district under 28 U.S.C. §§ 1391(b)-(d) and 1400(b). Defendant Samsung is registered to do business in the State of Texas, has offices in the State of Texas, has transacted business in the Eastern District of Texas and has committed acts of direct and indirect infringement in the Eastern District of Texas.

11. Samsung has a regular and established place of business in this District and has committed acts of infringement in this District. Samsung has permanent office locations at: 776 Henrietta Creek Rd 55, Roanoke, Texas 76262-6398; 6625 Excellence Way, Plano, Texas 75023; and 2601 Preston Road, Frisco, Texas 75034.

12. Samsung employs full-time personnel such as sales personnel and engineers in this District

13. Samsung has also committed acts of infringement in this District by commercializing, marketing, selling, distributing, testing, and servicing certain Accused Products.

14. This Court has personal jurisdiction over Samsung. Samsung has conducted and does conduct business within the State of Texas. Samsung, directly or through subsidiaries or intermediaries (including distributors, retailers, and others), ships, distributes, makes, uses, offers for sale, sells, imports, and/or advertises (including by providing an interactive web page) its products and/or services in the United States and the Eastern District of Texas and/or contributes to and actively induces its customers to ship, distribute, make, use, offer for sale, sell, import, and/or advertise (including the provision of an interactive web page) infringing products and/or services in the United States and the Eastern District of Texas. Samsung, directly and through subsidiaries or intermediaries (including distributors, retailers, and others), has purposefully and voluntarily placed one or more of its infringing products and/or services, as described below, into the stream of commerce with the expectation that those products will be purchased and used by

customers and/or consumers in the Eastern District of Texas. These infringing products and/or services have been and continue to be made, used, sold, offered for sale, purchased, and/or imported by customers and/or consumers in the Eastern District of Texas. Samsung has committed acts of patent infringement within the Eastern District of Texas. Samsung interacts with customers in Texas, including through visits to customer sites in Texas. Through these interactions and visits, Samsung directly infringes the patents-in-suit. Samsung also interacts with customers who sell the Accused Products into Texas, knowing that these customers will sell the Accused Products into Texas, either directly or through intermediaries.

15. Samsung has minimum contacts with this District such that the maintenance of this action within this District would not offend traditional notions of fair play and substantial justice. Thus, the Court therefore has both general and specific personal jurisdiction over Samsung.

THE ASSERTED PATENTS

U.S. PATENT NO. 7,091,854

16. U.S. Patent No. 7,091,854 (the "'854 patent") entitled, *Multiple-Input Multiple-Output Wireless Sensor Networks Communications,* was filed on April 9, 2004. The '854 patent is subject to a 35 U.S.C. § 154(b) term extension of 187 days. MIMO Research, LLC is the owner by assignment of the '854 patent. A true and correct copy of the '854 patent is attached hereto as Exhibit A.

17. The '854 patent claims specific systems for wireless multiple-input multiple-output communication devices.

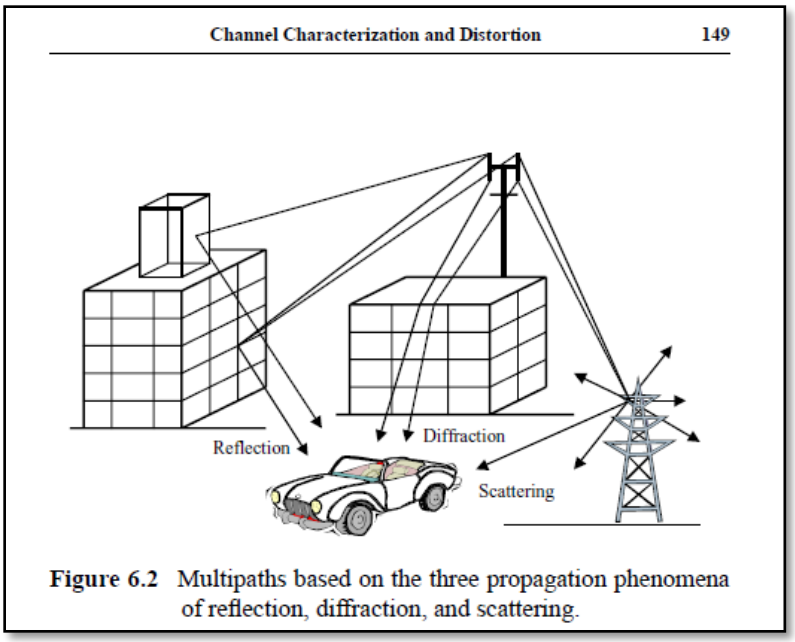
18. The '854 patent teaches the use of a MIMO sensor transmitter that improves array gain, diversity, and reduces channel interference and inter-symbol interference.

19. The ‘854 patent teaches the use of a sensor array unit coupled to an analog-to-digital converter which is coupled to a signal processing and data computing unit. The signal processing and data computing unit are coupled to a MIMO transceiver containing multiple antennas. This system improves average signal power, mitigates fading, and reduces channel interference and intersymbol interference. The reduction in channel and intersymbol interference allows the systems claimed in the ‘854 patent to significantly improve the capacity, coverage, and quality of wireless communication.

20. The inventions taught in the ‘854 patent boost the data rate not only on uplink channels but also on downlink channels, which allows for better communication and control between wireless devices.

21. The ‘854 patent teaches the use of a MIMO transceiver to overcome multipath propagation. Multipath propagation arises from scattering, reflection, refraction or diffraction of the radiated energy off objects in the environment. Thus, received signals are much weaker than transmitted signals due to mean propagation loss. In addition to a mean path loss, the received signals exhibit fluctuations in a signal level that is referred to fading.

22. The ‘854 patent is directed to overcoming problems attendant to multipath propagation which occurs through the reflection, diffraction, and scattering of a wireless signal. “The multipath propagation arises from scattering, reflection, refraction or diffraction of the radiated energy off objects in the environment.” ‘854 patent, col. 2:43-45. The inventor of the ‘854 patent illustrated the problem of multipath propagation in a subsequent textbook on signal processing.



George J. Maio, SIGNAL PROCESSING IN DIGITAL COMMUNICATIONS at 149 (2006).

23. The '854 patent teaches the use of a MIMO transceiver which turns multipath propagation into a benefit. By combining the use of the transmitter antennas at one end and receiver antennas, the systems taught in the '854 patent enhance wireless transmission over the MIMO channel.

24. The inventor of '854 patent described the problem of multipath propagation in a 2006 textbook on signal processing:

> Wireless channels experience multipath propagation due to reflection, diffraction, and/or scattering of radiated energy off of objects located in the environment. Signals at the receiver are much feebler than transmitted signals because of propagation path loss. In addition, received signals may display fading over traveling distance from the transmitter. The fading includes large-scale fading and small-scale fading.

George J. Maio, SIGNAL PROCESSING IN DIGITAL COMMUNICATIONS at 184-85 (2006).

25. The '854 patent has been cited by 61 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the '854 patent as relevant prior art:

- Qualcomm, Inc.

- NEC Corporation
- ***Samsung Electronics Co., Ltd.***
- Allied Telesis Holdings K.k.
- University Of Virginia
- Texas Instruments Incorporated
- Honeywell International Inc.
- Shanghai Jiaotong University
- Zebra Technologies Corp.
- The Boeing Company
- Chinese Academy of Sciences
- Itron, Inc.
- HBX Control Systems, Inc.

U.S. PATENT NO. 7,046,716

26. U.S. Patent No. 7,046,716 (the "'716 patent") entitled, *Dual-Mode Ultra Wideband and Wireless Local Area Network Communications*, was filed on July 14, 2003. The '716 patent is subject to a 35 U.S.C. § 154(b) term extension of 342 days. MIMO Research, LLC is the owner by assignment of the '716 patent. A true and correct copy of the '716 patent is attached hereto as Exhibit B.

27. The '716 patent discloses the use of a dual-mode UWB and wireless local area network transceiver.

28. The '716 patent is directed to enabling network devices operating using wireless spectrum occupied by existing radio services without causing interference, thereby permitting scare spectrum resources to be used more efficiently.

29. The '716 patent discloses novel systems for allowing the coexistence of a UWB and WLAN transceiver in an environment.

30. The inventions disclosed in the '716 patent enable the use of communications device that operates using a transceiver that operates using more than one wireless networking standards and enables the same communication device to operate in areas in which there is a need for short-range wireless broadband communications using UWB.

31. The communication transceiver disclosed in the '716 patent can be implemented in hardware such as an in an Application Specific Integrated Circuits (ASIC), digital signal processor, field programmable gate array (FPGA), software, or a combination of hardware and software.

32. The '716 patent has been cited by 93 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the '716 patent as relevant prior art:

- Samsung Electronics Co., Ltd.
- Qualcomm, Inc.
- Huawei Investment & Holding Co., Ltd.
- Nokia Corporation
- NXP B.V.
- Intel Corporation
- Microchip Technology Inc.
- Corning Incorporated
- L3Harris Technologies Inc.
- Siemens AG
- Kawasaki Microelectronics, Inc.

U.S. PATENT NO. 7,133,646

33. U.S. Patent No. 7,133,646 (the "'646 patent") entitled, *Multimode and Multiband MIMO Transceiver of W-CDMA, WLAN and UWB Communications*, was filed on December 29, 2003. The '646 patent is subject to a 35 U.S.C. § 154(b) term extension of 456 days. MIMO Research, LLC is the owner by assignment of the '646 patent. A true and correct copy of the '646 patent is attached hereto as Exhibit C.

34. The '646 patent discloses novel methods and systems for implementing a processor-based system to receive W-CDMA, WLAN, and UWB signals.

35. The inventions disclosed in the '646 patent enable large-scale computer networks to quickly recover from a component failure.

36. The ‘646 patent discloses a method implemented on a transceiver system for multimode receipt of W-CDMA, WLAN, and UWB signals.

37. The ‘646 patent has been cited by 108 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘646 patent as relevant prior art:

- Sharp Corporation
- Apple Inc.
- Sony Group Corporation
- International Business Machines Corp.
- Qualcomm, Inc.
- Huawei Investment & Holding Co., Ltd.
- NXP B.V.
- Koninklijke Philips Electronics, N.V.
- Broadcom Limited
- Intel Corporation
- Fujitsu Limited
- Electronics And Telecommunications Research Institute
- Infineon Technologies AG

U.S. PATENT NO. 7,305,057

38. U.S. Patent No. 7,305,057 entitled, *Multichannel Filter-Based Handheld Ultra Wideband Communications*, was filed on July 7, 2003. The ‘057 patent is subject to a 35 U.S.C. § 154(b) term extension of 922 days. MIMO Research, LLC is the owner by assignment of the ’057 patent. A true and correct copy of the ‘057 patent is attached hereto as Exhibit D.

39. The ‘057 patent discloses novel systems for multichannel filter-based UWB transceivers that avoid interference with WLAN 802.11a devices.

40. The inventions disclosed in the ‘057 patent teach systems that permit a UWB device to operate using spectrum occupied by existing radio services without causing interference, thereby permitting scarce spectrum resources to be used more efficiently.

41. The ‘057 patent improves the operation of wireless networks by disclosing technologies that enable new products incorporating UWB technology.

42. The ‘057 patent discloses the use of a multichannel filter for a UWB transceiver. The multichannel filter allows the UWB transceiver to operate in the frequency band from 3.1 GHz to 10.6 GHz, with a conservative out of band emission mask to address interference with other devices.

43. The ‘057 patent has been cited by 16 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the ‘057 patent as relevant prior art:

- University Of Minnesota
- Sorbonne Université
- Qualcomm, Inc.
- Nokia Corporation
- Huawei Technologies Co., Ltd.
- Industrial Technology Research Institute
- Graz University of Technology (Austria)

U.S. PATENT NO. 7,433,382

44. U.S. Patent No. 7,433,382 entitled, *Spread Spectrum Based Multichannel Modulation for Ultra Wideband Communications*, was filed on July 7, 2003. The ‘382 patent is subject to a 35 U.S.C. § 154(b) term extension of 704 days. MIMO Research, LLC is the owner by assignment of the ’382 patent. A true and correct copy of the ‘382 patent is attached hereto as Exhibit E.

45. The ‘382 patent discloses novel UWB devices that enable the transmission of data while avoiding interference with WLAN 802.11a devices.

46. The inventions disclosed in the ‘382 patent are directed to solving the problem of interference between UWB devices and other devices, such as WLAN 802.11a devices.

Interference between UWB and 802.11a transmission was a problem at the time the inventions disclosed in the '382 patent were invented because the WLAN 802.11a devices operated in the frequency ranges 5.15 GHz to 5.35 GHz and 5.725 GHz to 5.825 GHz which overlapped with UWB signals that could operate in the frequency band of 3.1 GHz to 10.6 GHz.

47. The inventions disclosed in the '382 patent teach technologies that permit the transmission of data using UWB without interfering with the transmission of data using non-UWB signals that overlap with the UWB frequency band.

48. To address the issue of interference between devices operating in the UWB frequency band and non-UWB signals sent in an overlapping frequency band, the '382 patent teaches the use of multichannel pseudorandom noise mapping comprising N-I delay units coupled to N down sampling units followed by N Exclusive OR (XOR) units in parallel.

49. The '382 patent discloses systems that improve the operation of wireless networks by disclosing technologies that reduce interference with WLAN signals using a multichannel pseudorandom noise look-up table coupled to a multichannel sequence mapping component.

50. The '382 patent discloses the use of a digital finite impulse response shaping filter that attenuates signals with frequencies higher then specific thresholds. By using the disclosed filter, the systems taught in the '382 patent reduce interference with non-UWB signal.

51. The '382 patent has been cited by 10 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies and research institutions have cited the '382 patent as relevant prior art:

- STMicroelectronics N.V.
- Industrial Technology Research Institute
- Huawei Technologies Co., Ltd.
- East China Normal University
- Beifang Tongyong Electronics Group Co., Ltd.
- Universite De Provence

COUNT I
INFRINGEMENT OF U.S. PATENT NO. 7,091,854

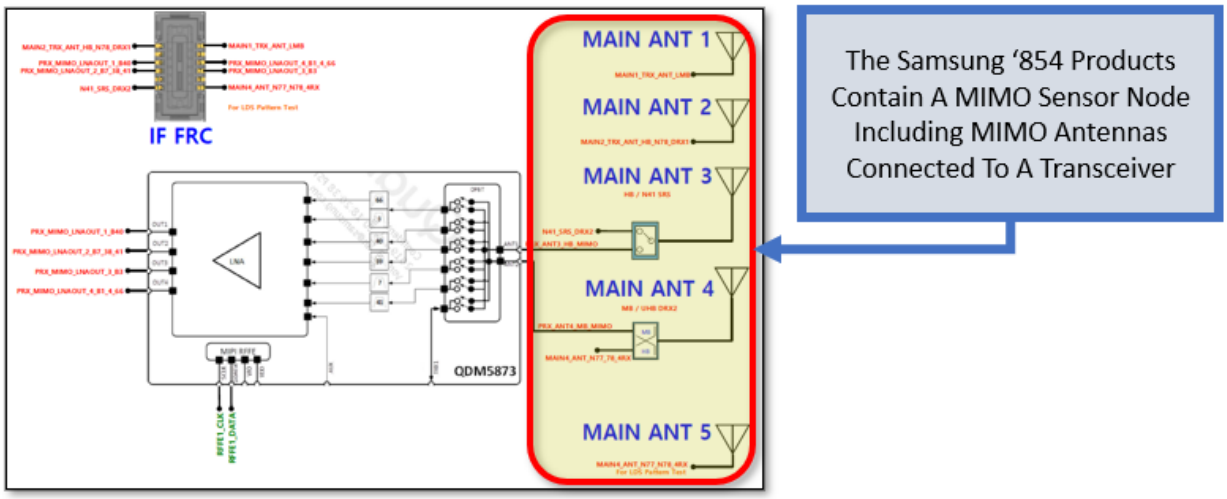
52. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

53. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products comprising a MIMO wireless sensor and transceiver system.

54. Samsung designs, makes, sells, offers to sell, imports, and/or uses the following products: Galaxy Z Fold2 (SM-F916B, SM-F916JPN, SM-F916U), Galaxy Z Fold3 (SM-F926B, SM-F926JPN, SM-F926U), Galaxy S21+ (SM-G996B, SM-G996B/DS, SM-G996U, SM-G996U1), Galaxy S21 Ultra (SM-G998B, SM-G998B/DS, SM-G998U, SM-G998U1), Galaxy S22+ (SM-S906B, SM-S906B/DS, SM-S906U, SM-S906U1), and Galaxy S22 Ultra (SM-S908B, SM-S908B/DS, SM-S908U, SM-S908U1) (collectively, the "Samsung '854 Product(s)").

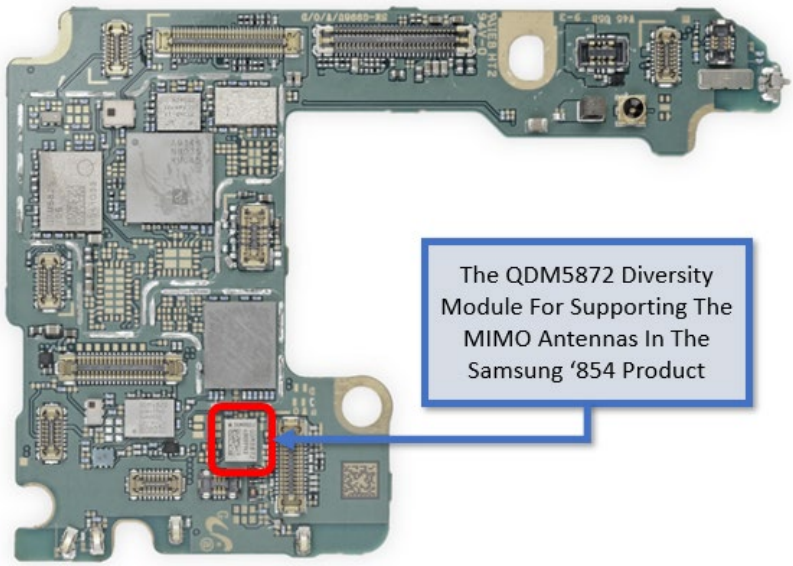
55. One or more Samsung subsidiaries and/or affiliates use the Samsung '854 Products in regular business operations.

56. One or more of the Samsung '854 Products include technology for a wireless multiple-input multiple-output sensor node and transceiver system. The below excerpt from a schematic of the Samsung S21 Ultra device shows one example of a MIMO sensor node connected to a transceiver system.



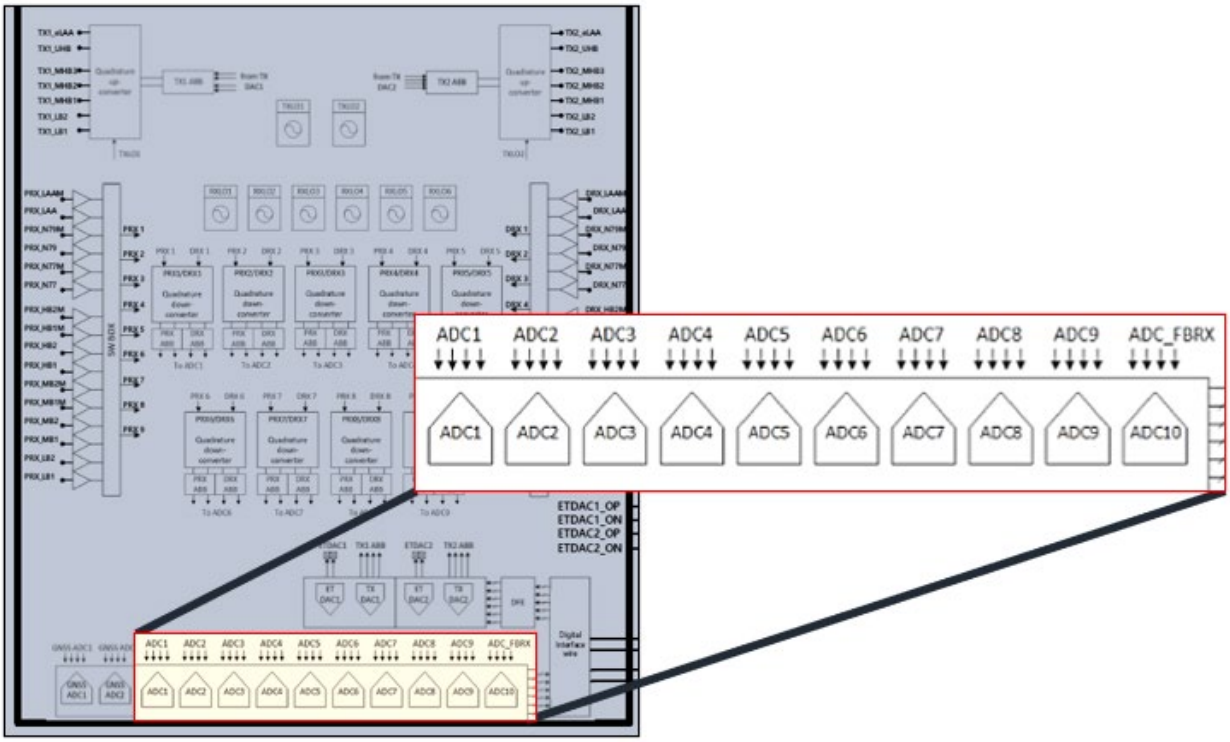
SAMSUNG SM-G998B RF BLOCK DIAGRAM (November 12, 2020) (annotation added).

57. One or more of the Samsung '854 Products include diversity modules including the Qualcomm QDM5872 FEM. The QDM5872 in the Samsung '854 Products features an integrated 5G/4G low-noise amplifier and filters for receive diversity and MIMO support for sub-6 GHz bands.



iFixIt Samsung Galaxy S21 Ultra Teardown, IFIXIT WEBSITE (2021), *available at*: https://www.ifixit.com/Teardown/Samsung+Galaxy+S21+Ultra+Teardown/141188 (annotation added).

58. One or more of the Samsung '854 Products include a sensor array unit coupled to an analog-to-digital converter unit. Specifically, the Samsung '854 Products include a sensor array unit (e.g., 4x4 MIMO for receiving four simultaneous data streams). The sensor array unit is connected to analog-to-digital (ADC) structures in the device. The below excerpt from Samsung documentation shows ADC structures that are coupled to the sensor array unit.

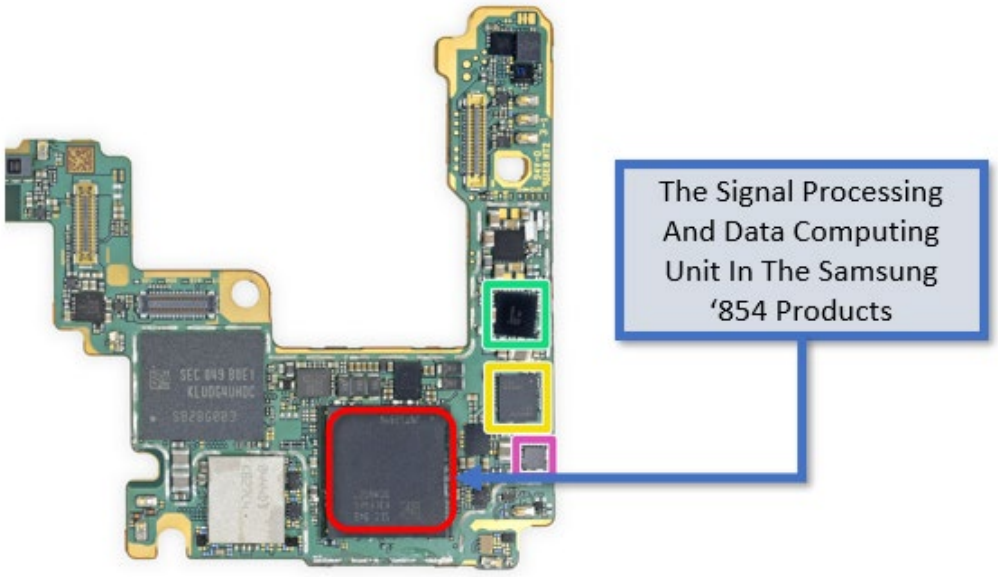


SAMSUNG SM-G998B RF BLOCK DIAGRAM (November 12, 2020) (annotation added).

59. One or more of the Samsung '854 Products comprise technology for an analog-to-digital converter unit coupled to a signal processing and data computing unit. For example, the Samsung Products contain integrated circuits that perform signal processing and data computing. These integrated circuits are connected to the transmission systems of the Samsung '854 Products that comprise technology to convert signals from analog to digital signals.

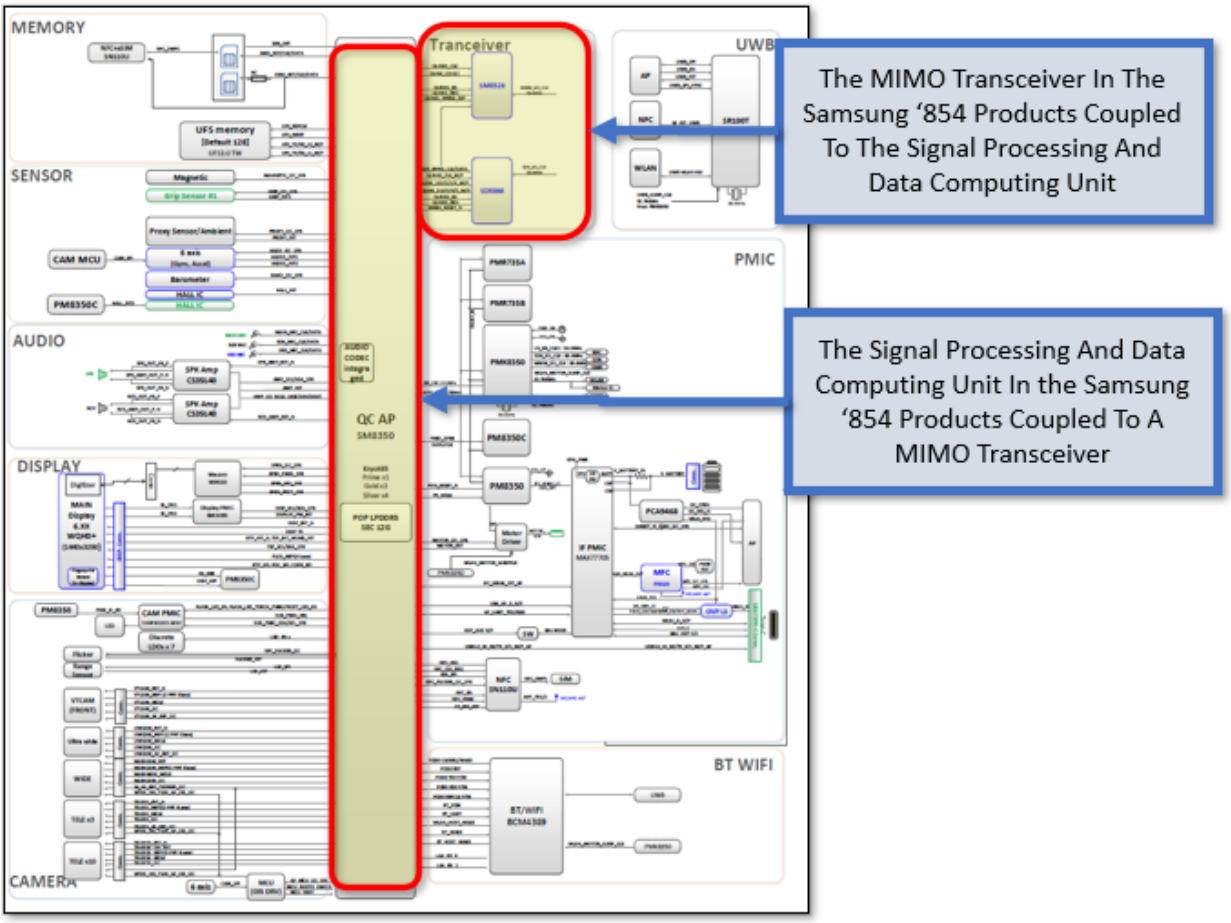
60. The Samsung '854 Products contain an analog-to-digital (ADC) converter unit coupled to a signal processing and data computing unit. Specifically, the Samsung '854 Products

contain a signal processing and data computing unit. For example, Samsung S21 Ultra contains a SM8350 application/baseband processor.



iFixIt Samsung Galaxy S21 Ultra Teardown, IFIXIT WEBSITE (2021), *available at*: https://www.ifixit.com/Teardown/Samsung+Galaxy+S21+Ultra+Teardown/141188 (annotation added).

61. One or more of the Samsung '854 Products include a signal processing and data computing unit that is coupled to a multiple-input multiple-output space-time transceiver that is connected to two or more antennas. The below diagram shows one example of the infringing functionality wherein antennas are coupled to the signal processing and data computing unit.

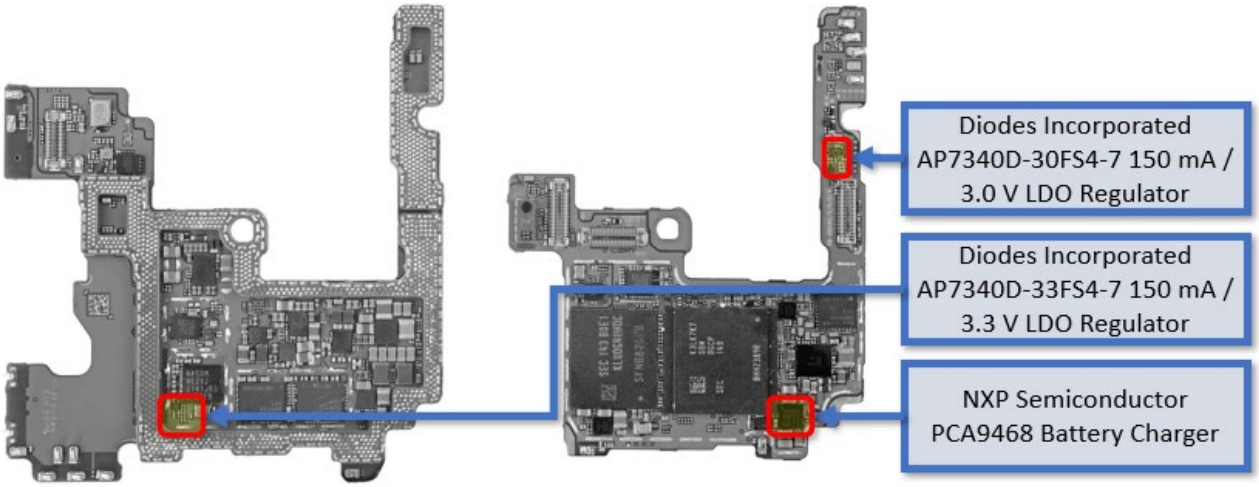


SAMSUNG SM-G998U LOGIC BLOCK DIAGRAM REV.0.4 (November 26, 2020) (annotation added).

62. One or more of the Samsung '854 Products include a signal processing and data computing unit that is coupled to a multiple-input multiple-output space-time transceiver that is connected to two or more antennas.

63. One or more of the Samsung '854 Products include memory that is coupled to the analog-to-digital converter unit, the signal processing and data computing unit, and the multiple-input multiple-output space-time transceiver.

64. One or more of the Samsung '854 Products include a power generator coupled to a power unit. The power unit and power generator include devices made by Diodes Incorporated and NXP Semiconductor. Specifically, Samsung documentation for the infringing products shows a power regulator connected to the power unit (supply voltages).



iFixIt Samsung Galaxy S22 Ultra Teardown, IFIXIT WEBSITE (2022), *available at*: https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 (annotation added).

65. One or more of the Samsung '854 Products include a power unit that is connected to the sensor array unit, the analog-to-digital converter unit, the signal processing and data computing unit, and the multiple-input multiple-output space-time transceiver.

66. Samsung has directly infringed and continues to directly infringe the '854 patent by, among other things, making, using, offering for sale, and/or selling technology for MIMO wireless sensor networks, including but not limited to the Samsung '854 Products.

67. The Samsung '854 Products are available to businesses and individuals throughout the United States.

68. The Samsung '854 Products are provided to businesses and individuals located in the Eastern District of Texas.

69. By making, using, testing, offering for sale, and/or selling products and services that comprise a MIMO wireless sensor, including but not limited to the Samsung '854 Products, Samsung has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '854 patent, including at least claim 15 pursuant to 35 U.S.C. § 271(a).

70. Samsung also indirectly infringes the '854 patent by actively inducing infringement under 35 U.S.C. § 271(b).

71. Samsung has had knowledge of the '854 patent since at least service of this Complaint or shortly thereafter, and Samsung knew of the '854 patent and knew of its infringement, including by way of this lawsuit.

72. Alternatively, Samsung has had knowledge of the '854 patent since at least September 5, 2007, when the '854 patent was identified by the Patent and Trademark Office as relevant prior art during the prosecution of U.S. Patent Application No. 11/047,766. U.S. Patent Application No. 1/047,766 is assigned to Samsung and would issue as U.S. Patent No. 7,392,012 on June 24, 2008. Further, U.S. Patent No. 7,392,012 is assigned to Samsung and cites the '854 patent as relevant prior art.

Notice of References Cited	Application/Control No. 11/047,766	Applicant(s)/Patent Under Reexamination OH ET AL.	
	Examiner SIMON D. NGUYEN	Art Unit 2618	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2003/0076908	04-2003	Huang et al.	375/350
*	B	US-2005/0053172	03-2005	Heikkila, Markku J.	375/333
*	C	US-7,016,658	03-2006	Kim et al.	455/102
*	D	US-2004/0120274	06-2004	Petre et al.	370/320
*	E	US-2004/0001426	01-2004	Mailaender et al.	370/203
*	F	US-2006/0274844	12-2006	Walton et al.	375/260
*	G	US-7,091,854	08-2006	Miao, George J.	340/539.26

US. PATENT APPLICATION NO. 11/047,766 LIST OF REFERENCES CITED BY EXAMINER at 1 (September 5, 2007) (emphasis added).

73. Samsung intended to induce patent infringement by third-party customers and users of the Samsung '854 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '854 patent. Samsung performed the acts that constitute induced infringement,

and would induce actual infringement, with knowledge of the '854 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '854 Products that have the capability of operating in a manner that infringe one or more of the claims of the '854 patent, including at least claim 15, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '854 Products to utilize the products in a manner that directly infringe one or more claims of the '854 patent.[9] By providing instruction and training to customers and end-users on how to use the Samsung '854 Products in a manner that directly infringes one or more claims of the '854 patent, including at least claim 15, Samsung specifically intended to induce infringement of the '854 patent. Samsung engaged in such inducement to promote the sales of the Samsung '854 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '854 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '854 patent, knowing that such use constitutes infringement of the '854 patent.

74. The '854 patent is well-known within the industry as demonstrated by multiple citations to the '854 patent in published patents and patent applications assigned to technology

[9] *See, e.g., Samsung Galaxy S21 5G | S21+5g | S21 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Unfold A World Of Possibilities – Samsung Galaxy Z Fold3 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G User Manual*, SAMSUNG DOCUMENTATION (2021); *Samsung S22 Ultra Official Unboxing,* SAMSUNG YOUTUBE CHANNEL (February 24, 2022), *available at*: https://www.youtube.com/watch?v=uF1KwScZI6I; *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G Quick Reference Guide*, SAMSUNG DOCUMENTATION (2021); *Introducing Galaxy S21 FE 5G*, SAMSUNG YOUTUBE CHANNEL (January 24, 2022), *available at*: https://www.youtube.com/watch?v=kdzpVHL3oyg; *Samsung Galaxy Z Fold2 5G Usual Manual,* SAMSUNG DOCUMENTATION (2022); *Samsung The Power To Work – Galaxy Note20 5G and Note20 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2020); and *Samsung Galaxy Note20 5G and Galaxy Note20 Ultra 5G Quick Reference Guide,* SAMSUNG DOCUMENTATION (2020).

companies and academic institutions. Samsung is utilizing the technology claimed in the '854 patent without paying a reasonable royalty. Samsung is infringing the '854 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

75. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '854 patent.

76. As a result of Samsung's infringement of the '854 patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

COUNT II
INFRINGEMENT OF U.S. PATENT NO. 7,046,716

77. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

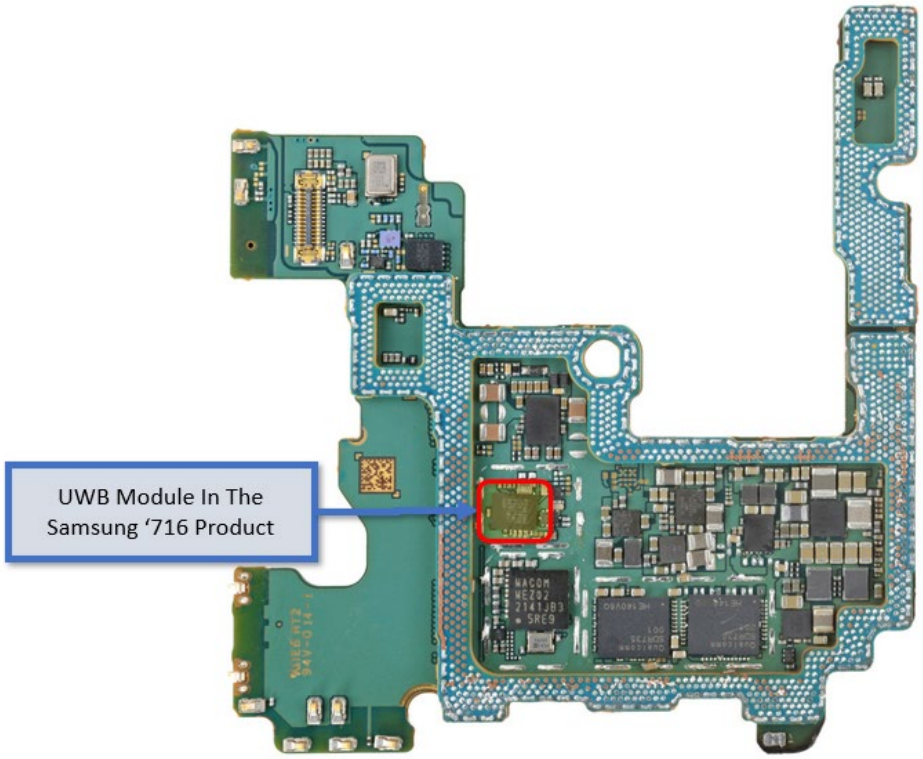
78. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products comprising a dual-mode ultra-wideband and wireless local area network transceiver.

79. Samsung designs, makes, sells, offers to sell, imports, and/or uses the following products: Galaxy Z Fold2 (SM-F916B, SM-F916JPN, SM-F916U), Galaxy Z Fold3 (SM-F926B, SM-F926JPN, SM-F926U), Galaxy S21+ (SM-G996B, SM-G996B/DS, SM-G996U, SM-G996U1), Galaxy S21 Ultra (SM-G998B, SM-G998B/DS, SM-G998U, SM-G998U1), Galaxy S22+ (SM-S906B, SM-S906B/DS, SM-S906U, SM-S906U1), Galaxy S22 Ultra (SM-S908B, SM-S908B/DS, SM-S908U, SM-S908U1), and Galaxy Note 20 Ultra (SM-N985F, SM-N985F/DS, SM-N986B, SM-N986U, SM-N986U1) (collectively, the "Samsung '716 Product(s)").

80. One or more Samsung subsidiaries and/or affiliates use the Samsung '716 Products in regular business operations.

81. One or more of the Samsung '716 Products are a dual-mode UWB and wireless local area network transceiver.

82. The Samsung '716 Products comprise a dual-mode ultra-wideband and wireless local area network multichannel-based multi-carrier system. Specifically, the Samsung '716 Products contain multichannel ultra-wideband functionality enabled by a SR100T UWB chipset. The following teardown of the Samsung S22 Ultra product shows the UWB module.



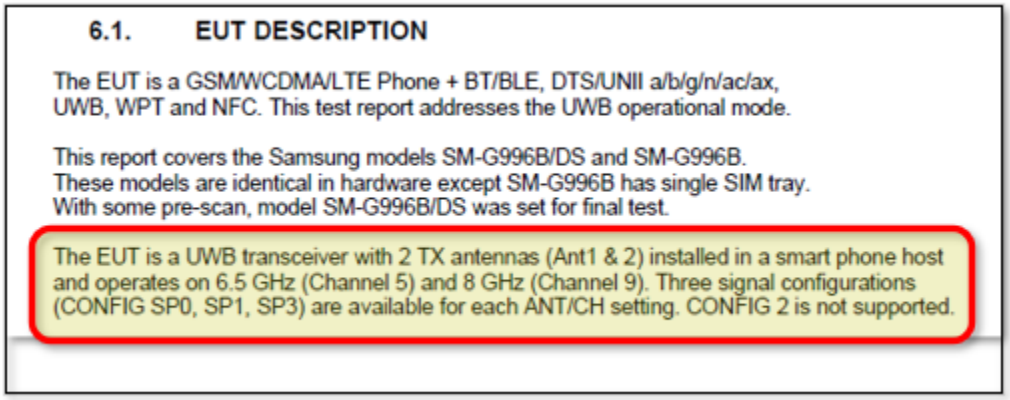
iFixIt Samsung Galaxy S22 Ultra Teardown, IFIXIT WEBSITE (2022), *available at*: https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 (annotation added).

83. The Samsung '716 Products contain an UWB module that is compliant with the 802.15.4z standard and FiRa Certified.

> The FiRa UWB based ranging and locationing uses the IEEE 802.15.4z standard amendment that adds PHY and MAC support for more accurate ranging and locationing to the IEEE 802.15.4 standard, and also adds additional security to the protocol. . . .The Samsung Galaxy S21 Ultra was one of the three initial certified devices, and the only device that was a complete product (the other two devices were NXP's chipset evaluation boards)."

Clint Chaplin and By Gyubong Oh, *FiRa Consortium Makes Available Certification For Fine Ranging MAC and PHY,* SAMSUNG RESEARCH BLOG (December 20, 2021), *available at*: https://research.samsung.com/blog/FiRa-Consortium-Makes-Available-Certification-for-Fine-Ranging-MAC-and-PHY (emphasis added).

84. The Samsung '716 Products contain an UWB Module that is connected to an antenna that operates in two frequencies and the signal is modulated using Binary Phase Shift Keying. The following excerpt from documentation submitted to the Federal Communications Commission shows that the UWB module can operate in multiple frequencies.



6.1. EUT DESCRIPTION

The EUT is a GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, UWB, WPT and NFC. This test report addresses the UWB operational mode.

This report covers the Samsung models SM-G996B/DS and SM-G996B. These models are identical in hardware except SM-G996B has single SIM tray. With some pre-scan, model SM-G996B/DS was set for final test.

The EUT is a UWB transceiver with 2 TX antennas (Ant1 & 2) installed in a smart phone host and operates on 6.5 GHz (Channel 5) and 8 GHz (Channel 9). Three signal configurations (CONFIG SP0, SP1, SP3) are available for each ANT/CH setting. CONFIG 2 is not supported.

Samsung SM-G996B/DS, SM-G996B – Report No. 4789633488-E9V3, FCC CERTIFICATION TEST REPORT at 7 (December 2, 2020) (emphasis added).

85. The Samsung '716 Products contain a digital-to-analog converter (DAC) that is coupled to an analog lowpass filter that is connected a mixer.

86. The Samsung '716 Products contain a mixer coupled to a power amplifier.

87. The Samsung '716 Products contain functionality for selecting a lower band and upper band mode for wireless local area network signal processing using multicarrier frequencies. For example, the Samsung '716 Products contain functionality for transmitting at two bands as shown in excerpts from two reports to the Federal Communications Commission.

The EUT is a GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, UWB, WPT and NFC. This test report addresses the NII (UNII 802.11a/n/ac/ax) operational mode.

This report covers the Samsung models SM-G996B/DS and SM-G996B.
These models are identical in hardware except SM-G996B has single SIM tray.
With some pre-scan, model SM-G996B/DS was set for final test.

Note. This EUT does not support channel puncturing.

WiFi operating mode

Frequency rage	Mode	ANT1	ANT2
5GHz (5180 MHz ~ 5825 MHz)	802.11a MIMO	TX/RX	TX/RX
	802.11n MIMO	TX/RX	TX/RX
	802.11ac MIMO	TX/RX	TX/RX
	802.11ax MIMO	TX/RX	TX/RX

The EUT is a GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, UWB, WPT and NFC. This test report addresses the DTS (WLAN) operational mode.

This report covers the Samsung models SM-G996B/DS and SM-G996B.
These models are identical in hardware except SM-G996B has single SIM tray.
With some pre-scan, model SM-G996B/DS was set for final test.

WiFi operating mode

Frequency rage	Mode	ANT 1	ANT 2
2.4GHz (2412 MHz ~ 2472 MHz)	802.11b SISO	TX/RX	TX/RX
	802.11g MIMO	TX/RX	
	802.11n(HT20) MIMO	TX/RX	
	802.11ax(HE20) MIMO	TX/RX	

Samsung SM-G996B/DS, SM-G996B – Report No. 4789633488-E9V2, FCC CERTIFICATION TEST REPORT at 9 (November 25, 2020) (emphasis added) and *Samsung SM-G996B/DS, SM-G996B – Report No. 4789633488-E3V2,* FCC CERTIFICATION TEST REPORT at 8 (November 25, 2020) (emphasis added).

88. The Samsung '716 Products comprise structures for ultra-wideband selectable multicarrier frequencies connected to the ultra-wideband commuter unit. For example, the Samsung '716 Products enable a dual-frequency modulation scheme where each symbol is modulated by means of PBFSK modulation wherein the signal is shifted from the center frequency of the UWB pulse carrier. This functionality is described in the IEEE 802.15.4z standard.

In the dual-frequency modulation scheme(s), each symbol is modulated by means of PBFSK modulation. The PBFSK modulation carrying binary values zero and one encodes them by shifting the center frequency of the UWB pulse carrier as described in Table 18-4a.

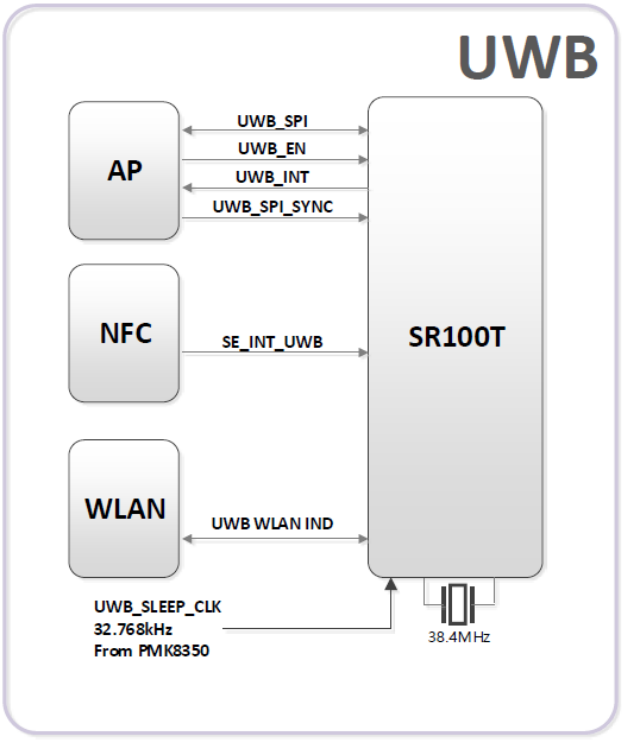
Table 18-4a—PBFSK pulse frequency encoding

Binary value being encoded	Transmitted pulse center frequency
0	The RF carrier of the pulse is shifted by $-f_{dev}$
1	The RF carrier of the pulse is shifted by $+f_{dev}$

The value of parameter f_{dev} is specified in 18.2.5.1.

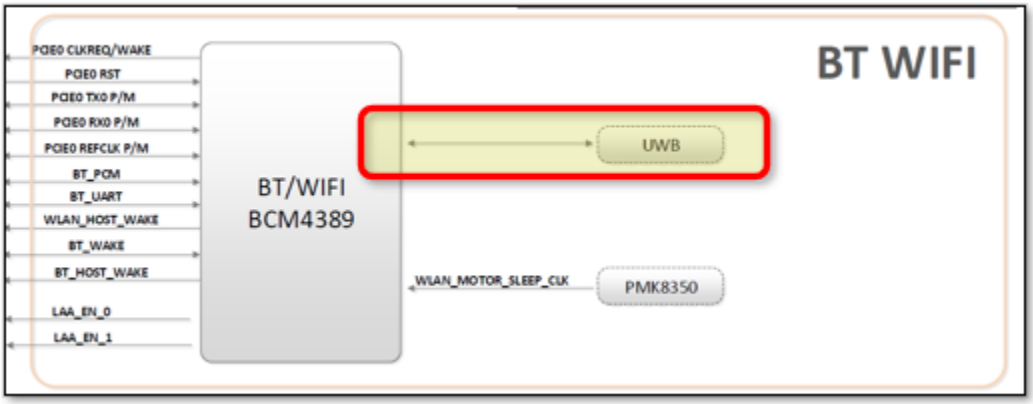
IEEE Std. 802.15.4z-2020 at § 18.2.5 (June 4, 2020).

89. The Samsung '716 Products contain a UWB commuter unit which contains a UWB switch. Specifically, the Samsung '716 Products including the Samsung Galaxy S21 Ultra contain connections on the UWB module as "UWB_WLAN_IND."



SAMSUNG SM-G998U LOGIC BLOCK DIAGRAM REV.0.4 (November 26, 2020).

90. Further, the Samsung '716 Products contain a connection between the UWB Module and the Bluetooth/WiFi module as shown in the below excerpt from a schematic of the Samsung S21 Ultra device.



SAMSUNG SM-G998U LOGIC BLOCK DIAGRAM REV.0.4 (November 26, 2020) (annotation added).

91. The Samsung '716 products contain integrated circuits that comprise switches including the SKY58269 and QM78217.

92. The Samsung '716 products contain a software control unit that contains functionality for selecting one of outputs from the ultra-wideband commuter unit, the lower-band wireless local area network commuter unit or the upper-band wireless local area network commuter unit to the mixer by controlling MUX (multiplexer) units.

93. Samsung has directly infringed and continues to directly infringe the '716 patent by, among other things, making, using, offering for sale, and/or selling technology comprising a dual-mode ultra-wideband and wireless local area network transceiver, including but not limited to the Samsung '716 Products.

94. The Samsung '716 Products are available to businesses and individuals throughout the United States.

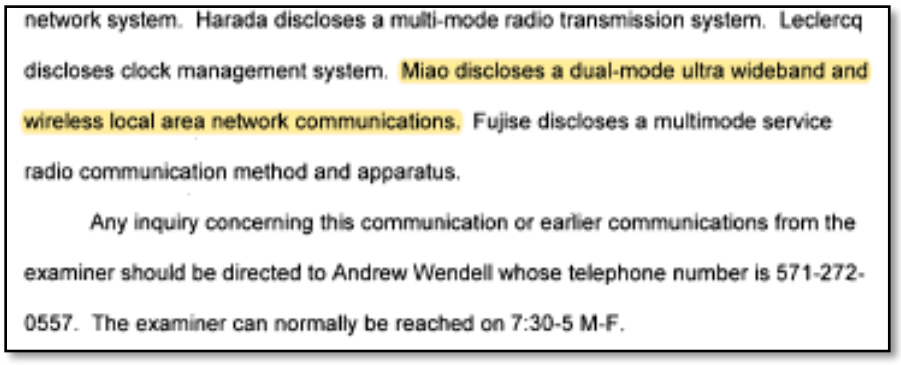
95. The Samsung '716 Products are provided to businesses and individuals located in the Eastern District of Texas.

96. By making, using, testing, offering for sale, and/or selling products and services comprising a dual-mode ultra-wideband and wireless local area network transceiver, including but not limited to the Samsung '716 Products, Samsung has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '716 patent, including at least claim 10 pursuant to 35 U.S.C. § 271(a).

97. Samsung also indirectly infringes the '716 patent by actively inducing infringement under 35 U.S.C. § 271(b).

98. Samsung has had knowledge of the '716 patent since at least service of this Complaint or shortly thereafter, and Samsung knew of the '716 patent and knew of its infringement, including by way of this lawsuit.

99. Alternatively, Samsung has had knowledge of the '716 patent since at least October 19, 2006, when Samsung was made aware of the '716 patent by the United States Patent and Trademark Office via a Non-Final Rejection during the prosecution of U.S. Patent Application No. 10/807,298.



network system. Harada discloses a multi-mode radio transmission system. Leclercq discloses clock management system. Miao discloses a dual-mode ultra wideband and wireless local area network communications. Fujise discloses a multimode service radio communication method and apparatus.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Wendell whose telephone number is 571-272-0557. The examiner can normally be reached on 7:30-5 M-F.

U.S. PATENT APPLICATION NO. 10/807,298 NON-FINAL REJECTION at 7 (October 19, 2006) (emphasis added).

100. Samsung is the assignee of U.S. Patent Application No. 10/807,298 which would later issue as U.S. Patent No. 7,305,250. Further, U.S. Patent No. 7,305,250 cites the '716 patent as relevant prior art.

101. Samsung intended to induce patent infringement by third-party customers and users of the Samsung '716 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '716 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '716 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '716 Products that have the capability of operating in a manner that infringe one or more of the claims of the '716 patent, including at least claim 10, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '716 Products to utilize the products in a manner that directly infringe one or more claims of the '716 patent.[10] By providing instruction and training to customers and end-users on how to use the Samsung '716 Products in a manner that directly infringes one or more claims of the '716 patent, including at least claim 10, Samsung specifically intended to induce infringement of the '716 patent. Samsung

[10] *See, e.g., Samsung Galaxy S21 5G | S21+5g | S21 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Unfold A World Of Possibilities – Samsung Galaxy Z Fold3 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G User Manual*, SAMSUNG DOCUMENTATION (2021); *Samsung S22 Ultra Official Unboxing,* SAMSUNG YOUTUBE CHANNEL (February 24, 2022), *available at*: https://www.youtube.com/watch?v=uF1KwScZI6I; *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G Quick Reference Guide*, SAMSUNG DOCUMENTATION (2021); *Introducing Galaxy S21 FE 5G*, SAMSUNG YOUTUBE CHANNEL (January 24, 2022), *available at*: https://www.youtube.com/watch?v=kdzpVHL3oyg; *Samsung Galaxy Z Fold2 5G Usual Manual,* SAMSUNG DOCUMENTATION (2022); *Samsung The Power To Work – Galaxy Note20 5G and Note20 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2020); and *Samsung Galaxy Note20 5G and Galaxy Note20 Ultra 5G Quick Reference Guide,* SAMSUNG DOCUMENTATION (2020).

engaged in such inducement to promote the sales of the Samsung '716 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '716 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '716 patent, knowing that such use constitutes infringement of the '716 patent.

102. The '716 patent is well-known within the industry as demonstrated by multiple citations to the '716 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '716 patent without paying a reasonable royalty. Samsung is infringing the '716 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

103. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '716 patent.

104. As a result of Samsung's infringement of the '716 patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

COUNT III
INFRINGEMENT OF U.S. PATENT NO. 7,133,646

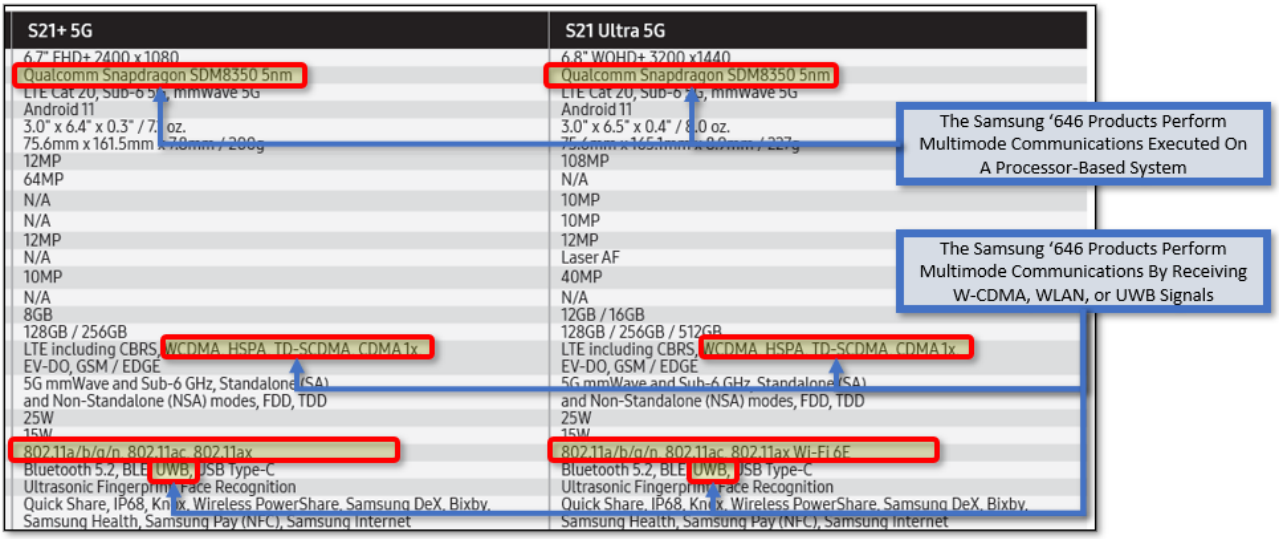
105. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

106. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products for receiving Wideband Code Division Multiple Access (W-CDMA), Wireless Local Area Network (WLAN), and Ultra-Wideband (UWB) Communications.

107. Samsung designs, makes, sells, offers to sell, imports, and/or uses the following products: Galaxy Z Fold2 (SM-F916B, SM-F916JPN, SM-F916U), Galaxy Z Fold3 (SM-F926B, SM-F926JPN, SM-F926U), Galaxy S21+ (SM-G996B, SM-G996B/DS, SM-G996U, SM-G996U1), Galaxy S21 Ultra (SM-G998B, SM-G998B/DS, SM-G998U, SM-G998U1), Galaxy S22+ (SM-S906B, SM-S906B/DS, SM-S906U, SM-S906U1), Galaxy S22 Ultra (SM-S908B, SM-S908B/DS, SM-S908U, SM-S908U1), and Galaxy Note 20 Ultra (SM-N985F, SM-N985F/DS, SM-N986B, SM-N986U, SM-N986U1) (collectively, the "Samsung '646 Product(s)").

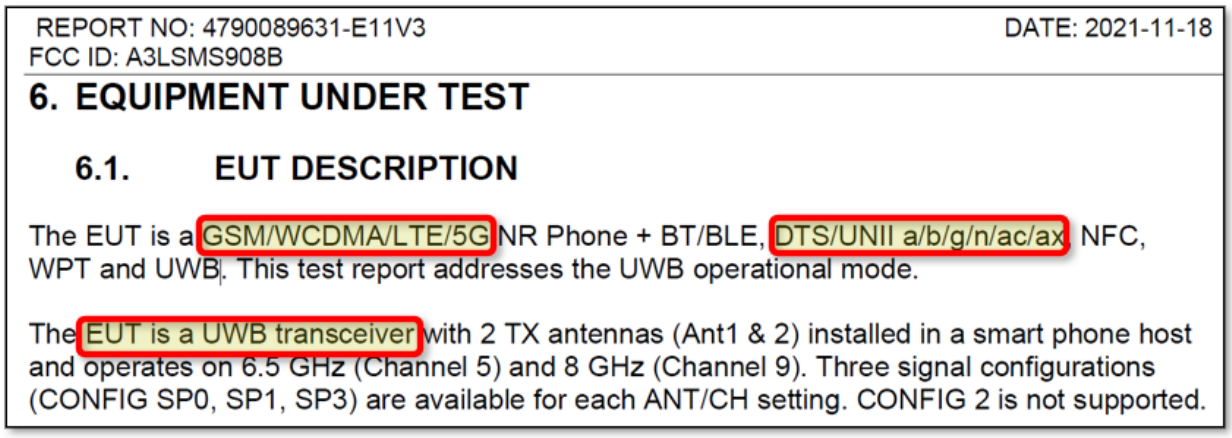
108. One or more Samsung subsidiaries and/or affiliates use the Samsung '646 Products in regular business operations.

109. One or more of the Samsung '646 Products perform the method of multimode communication based on a set of instructions adapted to be executed on a processor-based system. The following excerpt from Samsung documentation shows the Samsung '646 Products perform multimode communication on a processor-based system (e.g., Qualcomm Snapdragon SDM8350). The Samsung '646 Products receive and transmit W-CDMA, WLAN, and UWB signals.



Samsung Galaxy, S21, S21+, and S21 Ultra Datasheet at 4, SAMSUNG DOCUMENTATION (January 2021) (annotation added).

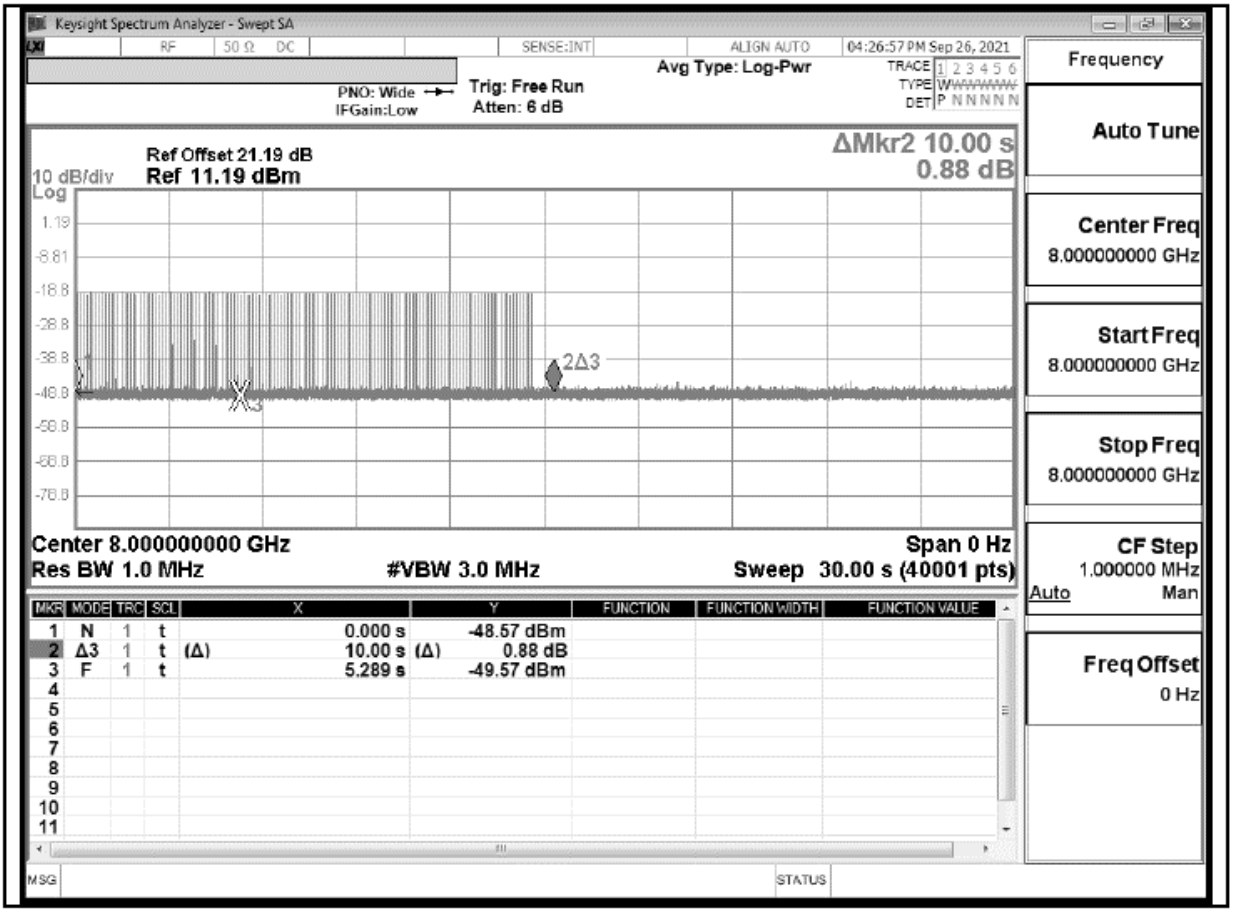
110. The Samsung '646 Products perform the step of setting the processor-based system in a receiver mode depending on whether received signals belong to W-CDMA, WLAN or UWB.



Samsung SM-S908B – Report No. 4790089631-E11V3, FCC CERTIFICATION TEST REPORT at 7 (November 18, 2021) (emphasis added).

111. The Samsung '646 Products perform the step of setting the processor-based system to perform a W-CDMA function and to turn off WLAN and UWB functions during W-CDMA mode. Specifically, the Samsung '646 Products enable W-CDMA functionality and disable WLAN and UWB functionality. The below excerpt from Samsung's submission to the Federal

Communications Commission shows that when no UWB signal is received the UWB functionality is turned off. Specifically, the UWB intentional radiator in the Samsung '646 Products ceases transmission within 10 seconds unless it receives an acknowledgement from an associated receiver that its transmission is being received. An acknowledgement of reception must continue to be received by the Samsung '646 Products at least every 10 seconds or the Samsung '646 Products will cease transmitting using UWB functionality.



Samsung SM-S908B – Report No. 4790089631-E11V3, FCC CERTIFICATION TEST REPORT at 23 (November 18, 2021) (showing the cessation of the UWB transmission).

112. The Samsung '646 Products perform the step of setting the processor-based system to perform the WLAN function and to turn off the W-CDMA and the UWB functions during WLAN mode.

113. The Samsung '646 Products support multiple power back-off modes including WWAN (Hotspot), WWAN (Proximity sensor), WWAN (ear-jack), WWAN (RCV), and WLAN (RCV). Each of the power back-Off operates within specific exposure conditions for certain technologies. Specifically, in WLAN (RCV) mode only WLAN and Bluetooth technologies are enabled. In WWAN (Hotspot) and WWAN (Proximity Sensor) mode WCDMA is turned on and WLAN functionality is not enabled.

Power Back-off mode	Technologies Supported	Exposure Conditions Active			
		Head	Body-worn	Hotspot	Product Specific 10-g
WWAN (Hotspot)	GSM 1900 WCDMA Band II & IV LTE Band 2 & 4 & 25 & 66 & 41 NR Band n66	N/A	N/A	✓	N/A
WWAN (Proximity sensor)	GSM 1900 WCDMA Band II & IV LTE Band 2 & 4 & 25 & 66 & 41 NR Band n66(Ant.1)	N/A	N/A	N/A	✓
WWAN (Ear-jack)	GSM 1900 WCDMA Band II & IV LTE Band 2 & 4 & 25 & 66 & 41	N/A	✓	N/A	✓
WWAN (RCV)	LTE Band 2 & 4 (Ant.3) NR Band n66(Ant.3)	✓	N/A	N/A	N/A
WLAN (RCV)	2.4GHz/5GHz WLAN & Bluetooth	✓	N/A	N/A	N/A

Samsung SM-S908B – Report No. 47980089631-S1V4, FCC SAR EVALUATION REPORT at 20 (December 22, 2021).

114. The Samsung '646 Products perform the step of setting the processor-based system to perform the UWB function and to turn off the W-CDMA and the WLAN functions during UWB mode.

115. Samsung has directly infringed and continues to directly infringe the '646 patent by, among other things, making, using, offering for sale, and/or selling technology for Wideband Code Division Multiple Access (W-CDMA), Wireless Local Area Network (WLAN), and Ultra Wideband (UWB) Communications, including but not limited to the Samsung '646 Products.

116. The Samsung '646 Products are available to businesses and individuals throughout the United States.

117. The Samsung '646 Products are provided to businesses and individuals located in the Eastern District of Texas.

118. By making, using, testing, offering for sale, and/or selling products and services for Wideband Code Division Multiple Access (W-CDMA), Wireless Local Area Network (WLAN), and Ultra Wideband (UWB) Communications, including but not limited to the Samsung '646 Products, Samsung has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '646 patent, including at least claim 16 pursuant to 35 U.S.C. § 271(a).

119. Samsung also indirectly infringes the '646 patent by actively inducing infringement under 35 U.S.C. § 271(b).

120. Samsung has had knowledge of the '646 patent since at least service of this Complaint or shortly thereafter, and Samsung knew of the '646 patent and knew of its infringement, including by way of this lawsuit.

121. Alternatively, Samsung has had knowledge of the '646 patent since at least April 15, 2008, when Samsung was made aware of the '646 patent by the United States Patent and Trademark Office via a Non-Final Rejection during the prosecution of U.S. Patent Application No. 11/314,454.

Notice of References Cited	Application/Control No. 11/314,454	Applicant(s)/Patent Under Reexamination KHAN ET AL.	
	Examiner PHUOC H. DOAN	Art Unit 2617	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0034165	02-2006	Levy, Joseph S.	370/208
*	B	US-2006/0109923	05-2006	Cai et al.	375/260
*	C	US-7,133,646	11-2006	Miao, George J.	455/73
*	D	US-2006/0135075	06-2006	Tee et al.	455/067.13
	E	US-			

U.S. PATENT APPLICATION NO. 11/314,454 NON-FINAL REJECTION – NOTICE OF REFERENCES CITED at 1 (April 15, 2008) (emphasis added).

122. Samsung is the assignee of U.S. Patent Application No. 11/314,454 which would later issue as U.S. Patent No. 7,969,859. Further, U.S. Patent No. 7, 969,859 cites the '646 patent as relevant prior art.

123. Samsung intended to induce patent infringement by third-party customers and users of the Samsung '646 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '646 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '646 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '646 Products that have the capability of operating in a manner that infringe one or more of the claims of the '646 patent, including at least claim 16, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '646 Products to utilize the products in a manner that directly infringe one or more claims of the '646 patent.[11] By providing instruction and training to customers and end-users on how to use the Samsung '646 Products in a manner that directly infringes one or more claims of the '646 patent, including at least claim 16, Samsung specifically intended to induce infringement of the '646 patent. Samsung

[11] *See, e.g., Samsung Galaxy S21 5G | S21+5g | S21 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (January 2021); *Unfold A World Of Possibilities – Samsung Galaxy Z Fold3 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G User Manual*, SAMSUNG DOCUMENTATION (2021); *Samsung S22 Ultra Official Unboxing,* SAMSUNG YOUTUBE CHANNEL (February 24, 2022), *available at*: https://www.youtube.com/watch?v=uF1KwScZI6I; *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G Quick Reference Guide*, SAMSUNG DOCUMENTATION (2021); *Introducing Galaxy S21 FE 5G*, SAMSUNG YOUTUBE CHANNEL (January 24, 2022), *available at*: https://www.youtube.com/watch?v=kdzpVHL3oyg; *Samsung Galaxy Z Fold2 5G Usual Manual,* SAMSUNG DOCUMENTATION (2022); *Samsung The Power To Work – Galaxy Note20 5G and Note20 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2020); and *Samsung Galaxy Note20 5G and Galaxy Note20 Ultra 5G Quick Reference Guide,* SAMSUNG DOCUMENTATION (2020).

engaged in such inducement to promote the sales of the Samsung '646 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '646 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '646 patent, knowing that such use constitutes infringement of the '646 patent.

124. The '646 patent is well-known within the industry as demonstrated by multiple citations to the '646 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '646 patent without paying a reasonable royalty. Samsung is infringing the '646 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

125. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '646 patent.

126. As a result of Samsung's infringement of the '646 patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

COUNT IV
INFRINGEMENT OF U.S. PATENT NO. 7,305,057

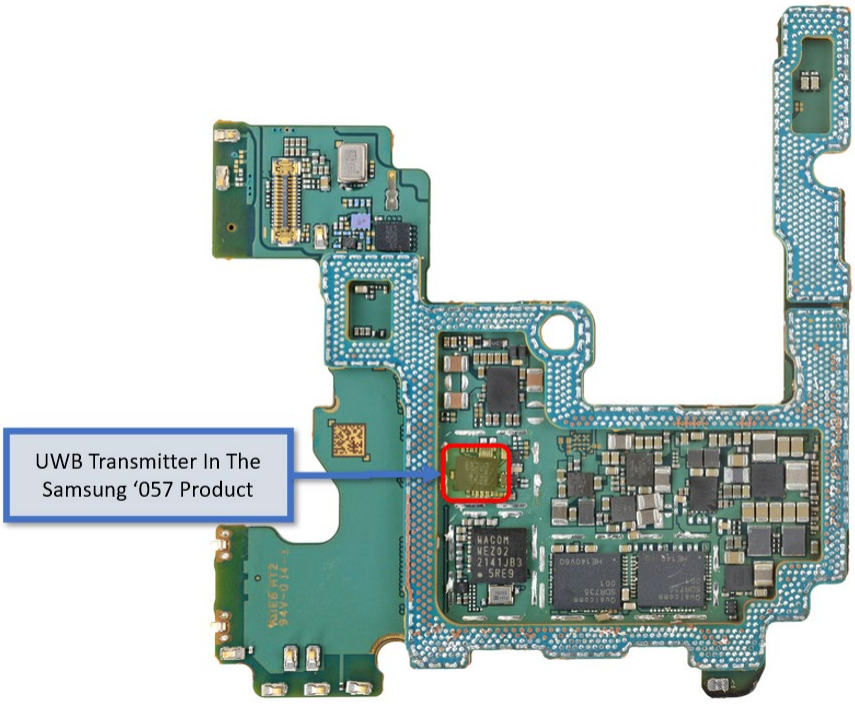
127. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

128. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products comprising a multichannel filter-based handheld Ultra-Wideband (UWB) communication transmitter.

129. Samsung designs, makes, sells, offers to sell, imports, and/or uses the following products: Galaxy Z Fold2 (SM-F916B, SM-F916JPN, SM-F916U), Galaxy Z Fold3 (SM-F926B, SM-F926JPN, SM-F926U), Galaxy S21+ (SM-G996B, SM-G996B/DS, SM-G996U, SM-G996U1), Galaxy S21 Ultra (SM-G998B, SM-G998B/DS, SM-G998U, SM-G998U1), Galaxy S22+ (SM-S906B, SM-S906B/DS, SM-S906U, SM-S906U1), Galaxy S22 Ultra (SM-S908B, SM-S908B/DS, SM-S908U, SM-S908U1), and Galaxy Note 20 Ultra (SM-N985F, SM-N985F/DS, SM-N986B, SM-N986U, SM-N986U1) (collectively, the "Samsung '057 Products(s)").

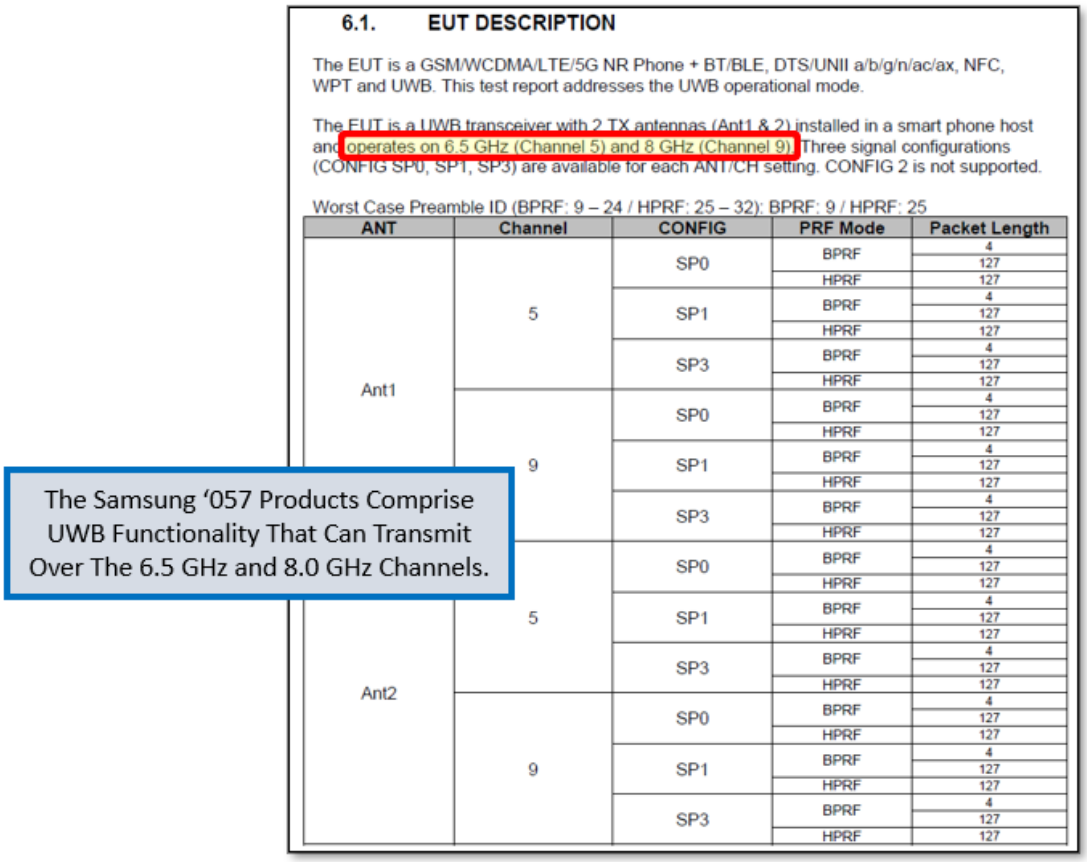
130. One or more Samsung subsidiaries and/or affiliates use the Samsung '057 Products in regular business operations.

131. One or more of the Samsung '057 Products comprise a UWB transmitter.



iFixIt *Samsung Galaxy S22 Ultra Teardown*, IFIXIT WEBSITE (2022), *available at*: https://www.ifixit.com/Guide/Samsung+Galaxy+S22+Ultra+Chip+ID/148073 (annotation added).

132. One or more of the Samsung '057 Products comprise a multichannel filter-based handheld UWB transmitter. Specifically, the Samsung '057 Products utilize multiple channels for precise UWB localization.



6.1. EUT DESCRIPTION

The EUT is a GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC, WPT and UWB. This test report addresses the UWB operational mode.

The EUT is a UWB transceiver with 2 TX antennas (Ant1 & 2) installed in a smart phone host and operates on 6.5 GHz (Channel 5) and 8 GHz (Channel 9). Three signal configurations (CONFIG SP0, SP1, SP3) are available for each ANT/CH setting. CONFIG 2 is not supported.

Worst Case Preamble ID (BPRF: 9 – 24 / HPRF: 25 – 32): BPRF: 9 / HPRF: 25

ANT	Channel	CONFIG	PRF Mode	Packet Length
Ant1	5	SP0	BPRF	4
				127
			HPRF	127
		SP1	BPRF	4
				127
			HPRF	127
		SP3	BPRF	4
				127
			HPRF	127
	9	SP0	BPRF	4
				127
			HPRF	127
		SP1	BPRF	4
				127
			HPRF	127
		SP3	BPRF	4
				127
			HPRF	127
Ant2	5	SP0	BPRF	4
				127
			HPRF	127
		SP1	BPRF	4
				127
			HPRF	127
		SP3	BPRF	4
				127
			HPRF	127
	9	SP0	BPRF	4
				127
			HPRF	127
		SP1	BPRF	4
				127
			HPRF	127
		SP3	BPRF	4
				127
			HPRF	127

The Samsung '057 Products Comprise UWB Functionality That Can Transmit Over The 6.5 GHz and 8.0 GHz Channels.

Samsung SM-S908B – Report No. 4790089631-E11V3, FCC CERTIFICATION TEST REPORT at 7 (November 18, 2021) (annotation added).

133. One or more of the Samsung '057 Products contain functionality that is compliant with the 802.15.4z standard and is FiRa Certified.

> The FiRa UWB based ranging and locationing uses the IEEE 802.15.4z standard amendment that adds PHY and MAC support for more accurate ranging and locationing to the IEEE 802.15.4 standard, and also adds additional security to the protocol. . . .The Samsung Galaxy S21 Ultra was one of the three initial certified devices, and the only device that was a complete product (the other two devices were NXP's chipset evaluation boards)."

Clint Chaplin and By Gyubong Oh, *FiRa Consortium Makes Available Certification For Fine Ranging MAC and PHY,* SAMSUNG RESEARCH BLOG (December 20, 2021), *available at*: https://research.samsung.com/blog/FiRa-Consortium-Makes-Available-Certification-for-Fine-Ranging-MAC-and-PHY (emphasis added).

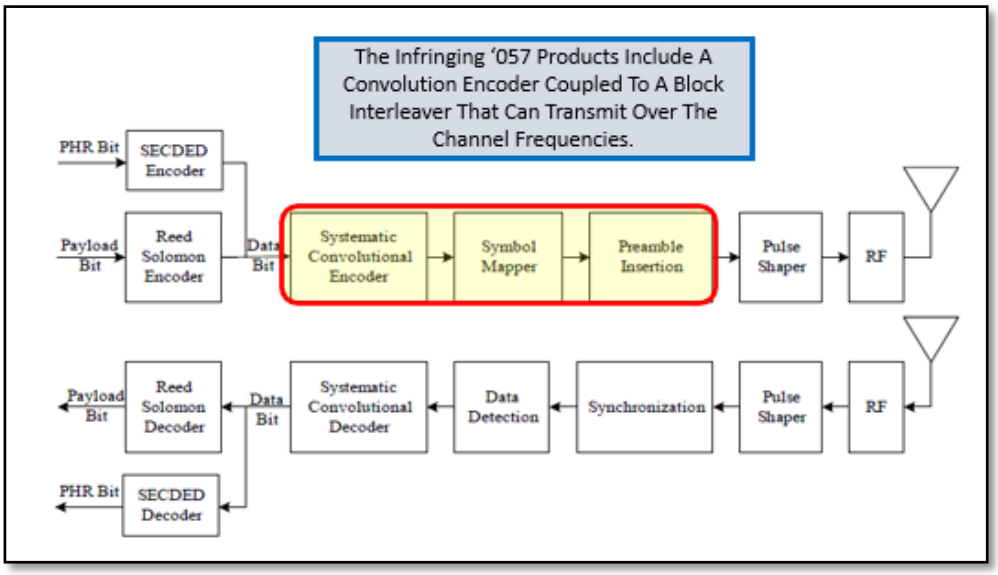
134. One or more of the Samsung '057 Products include a convolution encoder coupled to a block interleaver. Specifically, the forward error correction (FEC) "used by the HRP UWB PHY is a concatenated code consisting of an outer Reed-Solomon systematic block code and an

inner half-rate systematic convolutional code." IEEE STANDARD FOR LOW-RATE WIRELESS NETWORKS 802.15.4-2020 § 15.3.3.1 (2020).

> Data bits, as used in the PHY Header (PHR) and the PHY Service Data Unit (PSDU), are encoded using either a SECDED (PHR) or Reed-Solomon (PSDU) code, followed by convolutional encoding, after which the coded bits are mapped via Burst Position Modulation (BPM) and BPSK onto sets of multiple pulses called "bursts". The pulses within a burst are transmitted back-to-back, meaning without gaps on the 499.2 MHz chip grid. The (BPSK) polarities of the pulses, as well as the (BPM) burst timings, are scrambled using a linear feedback shift register (LFSR), in order to whiten the spectrum, so as not to cause spectral peaks which would degrade the allowable transmitted integrated band power. Scrambling also increases orthogonality between different transmitted signals, which may provide benefits in (co-channel) interference scenarios.

Frank Leong and Hans-Juergen Pirch, *Introduction to Impulse Radio UWB Seamless Access Systems*, FIRA WHITE PAPER at 9 (2020) (emphasis added).

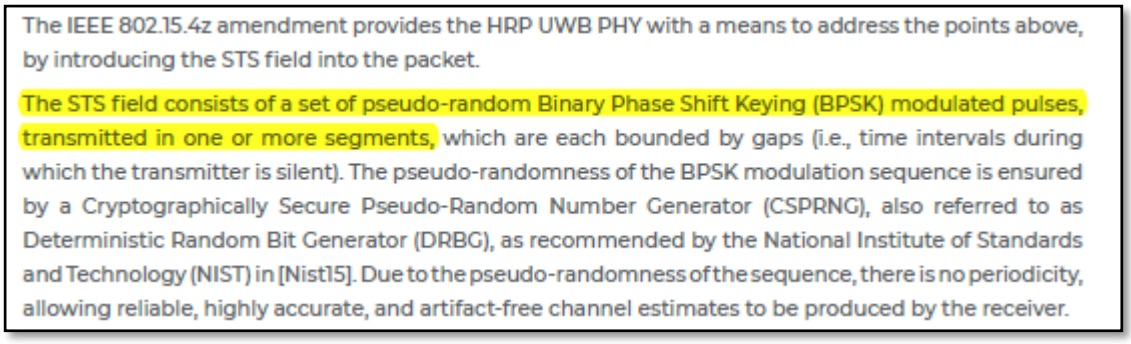
135. One or more of the Samsung '057 Products utilize a combination of BPM and BPSK to transmit and receive UWB signals over multiple channels. The combined BPM-BPSK is used to modulate symbols with each symbol composed of an active burst of UWB pulses. The following figure shows the sequence of processing steps used to create and modulate an HRP UWB PPDU by the Samsung '057 Products.



IEEE STANDARD FOR LOW-RATE WIRELESS NETWORKS 802.15.4-2020 § 15.1 (2020) (annotation added).

136. One or more of the Samsung '057 Products include a multichannel-based multicarrier modulator coupled to a power amplifier.

137. One or more of the Samsung '057 Products include a block interleaver coupled to a multichannel pseudorandom (PN) sequence mapping. Specifically, the Samsung '057 Products utilize a Cryptographically Secure Pseudo-Random Number Generator (CSPRNP), also referred to as a Deterministic Random Bit Generator (DRBG).

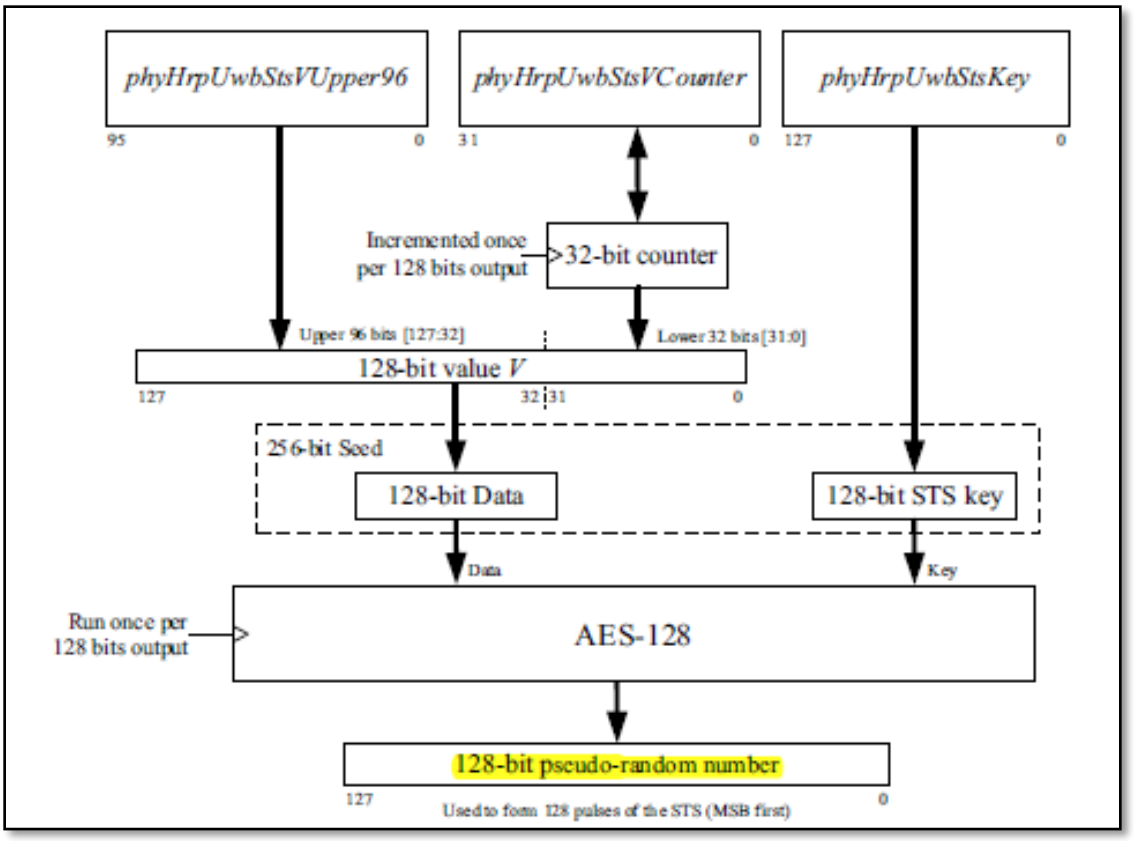


The IEEE 802.15.4z amendment provides the HRP UWB PHY with a means to address the points above, by introducing the STS field into the packet.

The STS field consists of a set of pseudo-random Binary Phase Shift Keying (BPSK) modulated pulses, transmitted in one or more segments, which are each bounded by gaps (i.e., time intervals during which the transmitter is silent). The pseudo-randomness of the BPSK modulation sequence is ensured by a Cryptographically Secure Pseudo-Random Number Generator (CSPRNG), also referred to as Deterministic Random Bit Generator (DRBG), as recommended by the National Institute of Standards and Technology (NIST) in [Nist15]. Due to the pseudo-randomness of the sequence, there is no periodicity, allowing reliable, highly accurate, and artifact-free channel estimates to be produced by the receiver.

Frank Leong and Hans-Juergen Pirch, *Introduction to Impulse Radio UWB Seamless Access Systems*, FIRA WHITE PAPER at 8 (2020) (emphasis added).

138. One or more of the Samsung '057 Products comprise a multichannel PN sequence mapping coupled to a digital UWB transmitter filter system. Each iteration of the CSPRNG/DRBG produces a 128-bit pseudo-random number. This transmits the most significant bit first, where each bit of value zero produces a positive polarity pulse and each bit of value one produces a negative polarity pulse. These pulses are spread and transmitted. The creation of the PM sequence mapping is shown in the below diagram.



IEEE STANDARD FOR LOW-RATE WIRELESS NETWORKS - AMENDMENT 1: ENHANCED ULTRA WIDEBAND (UWB) PHYSICAL LAYERS (PHYS) AND ASSOCIATED RANGING TECHNIQUES 802.15.4z-2020 § 15.2.9.1 (2020) (emphasis added).

139. One or more of the Samsung '057 Products include a pseudorandom sequence look-up table coupled to a multichannel pseudorandom sequence mapping component.

140. One or more of the Samsung '057 Products include a multichannel control coupled to the multichannel pseudorandom sequence mapping and coupled to the multichannel-based multicarrier modulator.

141. One or more of the Samsung '057 Products include a digital UWB transmitter filter system coupled to a digital-to-analog converter.

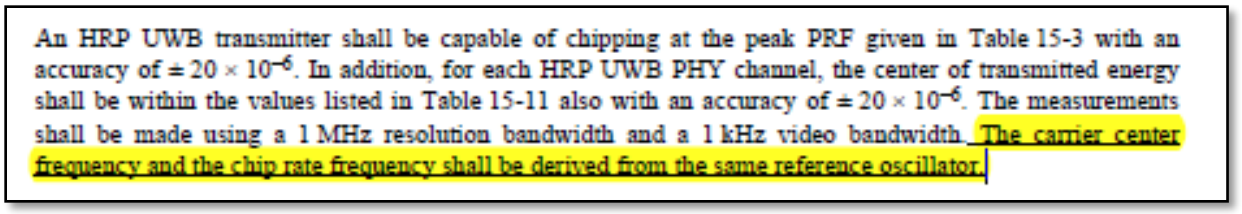
142. One or more of the Samsung '057 Products comprise a digital-to-analog converter (DAC) connected to a multichannel-based multicarrier modulator.

143. One or more of the Samsung '057 Products include a DAC that is connected to a modulator that transmits and receives UWB signals that have a center frequency of 6489 MHz, 6490 MHZ, and 7987 MHz. Each UWB channel has a bandwidth of between 500 MHz and 786 MHz.

ANT	Channel	CONFIG	PRF Mode	fM (MHz)	fL (MHz)	fH (MHz)	fc (MHz)	BW (MHz)
Ant1 Metal	CH5	SP0	BPRF4	6099.60	6096.10	6882.90	6489.50	786.80
			BPRF127	6879.91	6096.10	6883.15	6489.63	787.05
			HPRF127	**6100.35**	**6096.85**	**6883.00**	**6489.93**	**786.15**
		SP1	BPRF4	6100.10	6095.60	6882.50	6489.05	786.90
			BPRF127	**6099.10**	**6096.35**	**6883.00**	**6489.68**	**786.65**
			HPRF127	6099.35	6096.10	6883.00	6489.55	786.90
		SP3	BPRF4	6099.10	6096.60	6883.00	6489.80	786.40
			BPRF127	**6099.10**	**6097.85**	**6883.00**	**6490.43**	**785.15**
			HPRF127	6099.35	6096.85	6882.00	6489.43	785.15
	CH9	SP0	BPRF4	7597.35	7593.75	8380.40	7987.08	786.65
			BPRF127	7596.85	7593.50	8380.40	7986.95	786.90
			HPRF127	**7597.10**	**7594.00**	**8380.15**	**7987.08**	**786.15**
		SP1	BPRF4	7597.10	7593.60	8380.50	7987.05	786.90
			BPRF127	7597.10	7593.75	8380.50	7987.13	786.75
			HPRF127	**7597.10**	**7593.75**	**8380.25**	**7987.00**	**786.50**
		SP3	BPRF4	7596.85	7593.60	8380.75	7987.18	787.15
			BPRF127	7597.10	7593.60	8380.25	7986.93	786.65
			HPRF127	**7597.35**	**7593.85**	**8380.25**	**7987.05**	**786.40**
Ant2 Patch	CH5	SP0	BPRF4	6879.16	6096.60	6883.25	6489.93	786.65
			BPRF127	**6879.41**	**6096.35**	**6881.00**	**6488.68**	**784.65**
			HPRF127	6551.99	6096.35	6883.00	6489.68	786.65
		SP1	BPRF4	6879.16	6096.60	6883.00	6489.80	786.40
			BPRF127	6879.66	6096.35	6880.75	6488.55	784.40
			HPRF127	**6551.99**	**6098.60**	**6882.75**	**6490.68**	**784.15**
		SP3	BPRF4	6879.66	6096.35	6881.00	6488.68	784.65
			BPRF127	6880.15	6096.60	6881.50	6489.05	784.90
			HPRF127	**6551.99**	**6099.10**	**6882.75**	**6490.93**	**783.65**
	CH9	SP0	**BPRF4**	**8142.96**	**7595.10**	**8379.51**	**7987.31**	**784.41**
			BPRF127	8142.71	7594.85	8379.51	7987.18	784.66
			HPRF127	8049.49	7594.60	8379.76	7987.18	785.16
		SP1	BPRF4	8142.96	7594.85	8379.76	7987.31	784.91
			BPRF127	8142.96	7595.10	8379.51	7987.31	784.41
			HPRF127	**8049.49**	**7595.85**	**8379.26**	**7987.56**	**783.41**
		SP3	BPRF4	8061.48	7594.35	8380.25	7987.30	785.90
			BPRF127	8047.99	7594.35	8380.50	7987.43	786.15
			HPRF127	**8049.49**	**7594.60**	**8379.76**	**7987.18**	**785.16**

Samsung SM-S908B – Report No. 4790089631-E11V3, FCC CERTIFICATION TEST REPORT at 13 (November 18, 2021).

144. One or more of the Samsung '057 Products comprise a clock control coupled to the digital UWB transmitter filter system, the digital-to-analog converter, and the multichannel-based multicarrier modulator.


An HRP UWB transmitter shall be capable of chipping at the peak PRF given in Table 15-3 with an accuracy of $\pm 20 \times 10^{-6}$. In addition, for each HRP UWB PHY channel, the center of transmitted energy shall be within the values listed in Table 15-11 also with an accuracy of $\pm 20 \times 10^{-6}$. The measurements shall be made using a 1 MHz resolution bandwidth and a 1 kHz video bandwidth. The carrier center frequency and the chip rate frequency shall be derived from the same reference oscillator.

IEEE STANDARD FOR LOW-RATE WIRELESS NETWORKS - AMENDMENT 1: ENHANCED ULTRA WIDEBAND (UWB) PHYSICAL LAYERS (PHYS) AND ASSOCIATED RANGING TECHNIQUES 802.15.4z-2020 § 15.4.6 (2020) (emphasis added).

145. Samsung has directly infringed and continues to directly infringe the '057 patent by, among other things, making, using, offering for sale, and/or selling technology comprising a multichannel filter-based handheld ultra-Wideband (UWB) communication transmitter, including but not limited to the Samsung '057 Products.

146. The Samsung '057 Products are available to businesses and individuals throughout the United States.

147. The Samsung '057 Products are provided to businesses and individuals located in the Eastern District of Texas.

148. By making, using, testing, offering for sale, and/or selling products and services comprising a multichannel filter-based handheld ultra-Wideband (UWB) communication transmitter, including but not limited to the Samsung '057 Products, Samsung has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '057 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

149. Samsung also indirectly infringes the '057 patent by actively inducing infringement under 35 U.S.C. § 271(b).

150. Samsung has had knowledge of the '057 patent since at least service of this Complaint or shortly thereafter, and Samsung knew of the '057 patent and knew of its infringement, including by way of this lawsuit.

151. Samsung intended to induce patent infringement by third-party customers and users of the Samsung '057 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '057 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '057 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '057 Products that have the capability of operating in a manner that infringe one or more of the claims of the '057 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '057 Products to utilize the products in a manner that directly infringe one or more claims of the '057 patent.[12] By providing instruction and training to customers and end-users on how to use the Samsung '057 Products in a manner that directly infringes one or more claims of the '057 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '057 patent. Samsung engaged in such inducement to promote the sales of the Samsung '057 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '057 patent. Accordingly, Samsung has

[12] *See, e.g., Samsung Galaxy S21 5G | S21+5g | S21 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Unfold A World Of Possibilities – Samsung Galaxy Z Fold3 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G User Manual*, SAMSUNG DOCUMENTATION (2021); *Samsung S22 Ultra Official Unboxing,* SAMSUNG YOUTUBE CHANNEL (February 24, 2022), *available at*: https://www.youtube.com/watch?v=uF1KwScZI6I; *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G Quick Reference Guide*, SAMSUNG DOCUMENTATION (2021); *Introducing Galaxy S21 FE 5G*, SAMSUNG YOUTUBE CHANNEL (January 24, 2022), *available at*: https://www.youtube.com/watch?v=kdzpVHL3oyg; *Samsung Galaxy Z Fold2 5G Usual Manual,* SAMSUNG DOCUMENTATION (2022); *Samsung The Power To Work – Galaxy Note20 5G and Note20 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2020); and *Samsung Galaxy Note20 5G and Galaxy Note20 Ultra 5G Quick Reference Guide,* SAMSUNG DOCUMENTATION (2020).

induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '057 patent, knowing that such use constitutes infringement of the '057 patent.

152. The '057 patent is well-known within the industry as demonstrated by multiple citations to the '057 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '057 patent without paying a reasonable royalty. Samsung is infringing the '057 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

153. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '057 patent.

154. As a result of Samsung's infringement of the '057 patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

COUNT V
INFRINGEMENT OF U.S. PATENT NO. 7,433,382

155. Plaintiff references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

156. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products comprising a multichannel modulation Ultra-Wideband (UWB) communication transceiver.

157. Samsung designs, makes, sells, offers to sell, imports, and/or uses the following products: Galaxy Z Fold2 (SM-F916B, SM-F916JPN, SM-F916U), Galaxy Z Fold3 (SM-F926B,

SM-F926JPN, SM-F926U), Galaxy S21+ (SM-G996B, SM-G996B/DS, SM-G996U, SM-G996U1), Galaxy S21 Ultra (SM-G998B, SM-G998B/DS, SM-G998U, SM-G998U1), Galaxy S22+ (SM-S906B, SM-S906B/DS, SM-S906U, SM-S906U1), Galaxy S22 Ultra (SM-S908B, SM-S908B/DS, SM-S908U, SM-S908U1), and Galaxy Note 20 Ultra (SM-N985F, SM-N985F/DS, SM-N986B, SM-N986U, SM-N986U1) (collectively, the "Samsung '382 Products(s)").

158. One or more Samsung subsidiaries and/or affiliates use the Samsung '382 Products in regular business operations.

159. One or more of the Samsung '382 Products comprise a spread spectrum based multichannel modulation UWB communication transceiver. Specifically, the Samsung '382 Products utilize multichannel modulator in supporting UWB channels with a center frequency of 6489 MHz, 6490 MHZ, and 7987 MHz. Each UWB channel has a bandwidth of between 500 MHz and 786 MHz.

ANT	Channel	CONFIG	PRF Mode	fM (MHz)	fL (MHz)	fH (MHz)	fC (MHz)	BW (MHz)
Ant1 Metal	CH5	SP0	BPRF4	6099.60	6096.10	6882.90	6489.50	786.80
			BPRF127	6879.91	6096.10	6883.15	6489.63	787.05
			HPRF127	**6100.35**	**6096.85**	**6883.00**	**6489.93**	**786.15**
		SP1	BPRF4	6100.10	6095.60	6882.50	6489.05	786.90
			BPRF127	**6099.10**	**6096.35**	**6883.00**	**6489.68**	**786.65**
			HPRF127	6099.35	6096.10	6883.00	6489.55	786.90
		SP3	BPRF4	6099.10	6096.60	6883.00	6489.80	786.40
			BPRF127	**6099.10**	**6097.85**	**6883.00**	**6490.43**	**785.15**
			HPRF127	6099.35	6096.85	6882.00	6489.43	785.15
	CH9	SP0	BPRF4	7597.35	7593.75	8380.40	7987.08	786.65
			BPRF127	7596.85	7593.50	8380.40	7986.95	786.90
			HPRF127	**7597.10**	**7594.00**	**8380.15**	**7987.08**	**786.15**
		SP1	BPRF4	7597.10	7593.60	8380.50	7987.05	786.90
			BPRF127	7597.10	7593.75	8380.50	7987.13	786.75
			HPRF127	**7597.10**	**7593.75**	**8380.25**	**7987.00**	**786.50**
		SP3	BPRF4	7596.85	7593.60	8380.75	7987.18	787.15
			BPRF127	7597.10	7593.60	8380.25	7986.93	786.65
			HPRF127	**7597.35**	**7593.85**	**8380.25**	**7987.05**	**786.40**
Ant2 Patch	CH5	SP0	BPRF4	6879.16	6096.60	6883.25	6489.93	786.65
			BPRF127	**6879.41**	**6096.35**	**6881.00**	**6488.68**	**784.65**
			HPRF127	6551.99	6096.35	6883.00	6489.68	786.65
		SP1	BPRF4	6879.16	6096.60	6883.00	6489.80	786.40
			BPRF127	6879.66	6096.35	6880.75	6488.55	784.40
			HPRF127	**6551.99**	**6098.60**	**6882.75**	**6490.68**	**784.15**
		SP3	BPRF4	6879.66	6096.35	6881.00	6488.68	784.65
			BPRF127	6880.15	6096.60	6881.50	6489.05	784.90
			HPRF127	**6551.99**	**6099.10**	**6882.75**	**6490.93**	**783.65**
	CH9	SP0	**BPRF4**	**8142.96**	**7595.10**	**8379.51**	**7987.31**	**784.41**
			BPRF127	8142.71	7594.85	8379.51	7987.18	784.66
			HPRF127	8049.49	7594.60	8379.76	7987.18	785.16
		SP1	BPRF4	8142.96	7594.85	8379.76	7987.31	784.91
			BPRF127	8142.96	7595.10	8379.51	7987.31	784.41
			HPRF127	**8049.49**	**7595.85**	**8379.26**	**7987.56**	**783.41**
		SP3	BPRF4	8061.48	7594.35	8380.25	7987.30	785.90
			BPRF127	8047.99	7594.35	8380.50	7987.43	786.15
			HPRF127	**8049.49**	**7594.60**	**8379.76**	**7987.18**	**785.16**

Samsung SM-S908B – Report No. 4790089631-E11V3, FCC CERTIFICATION TEST REPORT at 13 (November 18, 2021).

160. The Samsung '382 Products comprise a spread spectrum physical layer (PHY). Specifically, the Samsung '382 Products enable what is "essentially a spread-spectrum PHY. Preamble symbols are repeated by the transmitter such that energy can be accumulated in the receiver and data symbols are spread across multiple pulses." Frank Leong and Hans-Juergen Pirch, *Introduction to Impulse Radio UWB Seamless Access Systems*, FIRA WHITE PAPER at 9 (2020).

161. The Samsung '382 Products contain a spread-spectrum PHY wherein the encoded block is spread and modulated using BPM-BPSK modulation such that the transmit waveform during the *k*th symbol interval may be expressed as follows:

$$x^{(k)}(t) = [1-2g_1^{(k)}] \sum_{n=1}^{N_{cpb}} [1-2s_{n+kN_{cpb}}] \times p(t-g_0^{(k)}T_{BPM}-h^{(k)}T_{burst}-nT_c)$$

IEEE STANDARD FOR LOW-RATE WIRELESS NETWORKS 802.15.4-2020 § 15.3.1 (2020).

162. The Samsung '382 Products use the spreading sequence to improve the interference rejection capabilities of the UWB PHY.

> Data bits, as used in the PHY Header (PHR) and the PHY Service Data Unit (PSDU), are encoded using either a SECDED (PHR) or Reed-Solomon (PSDU) code, followed by convolutional encoding, after which the coded bits are mapped via Burst Position Modulation (BPM) and BPSK onto sets of multiple pulses called "bursts". The pulses within a burst are transmitted back-to-back, meaning without gaps on the 499.2 MHz chip grid. The (BPSK) polarities of the pulses, as well as the (BPM) burst timings, are scrambled using a linear feedback shift register (LFSR), in order to whiten the spectrum, so as not to cause spectral peaks which would degrade the allowable transmitted integrated band power. Scrambling also increases orthogonality between different transmitted signals, which may provide benefits in (co-channel) interference scenarios.

Frank Leong and Hans-Juergen Pirch, *Introduction to Impulse Radio UWB Seamless Access Systems*, FIRA WHITE PAPER at 8 (2020).

163. One or more of the Samsung '382 Products contain a pseudorandom noise sequence look-up table coupled to a multichannel pseudorandom noise sequence mapping.

> [T]he BPSK modulated STS sequence is used for enabling secure ranging in HRP mode of IEEE 802.15.4. In absence of multi-path and receiver noise, HRP with STS can be used to implement a secure ranging system. In such a scenario the receiver might be able to decode most of the individual pulses of the STS sequence and can require high correlation of the received and template STS. Since an adversary is unable to predict the pseudo-randomly generated sequence it will not be able to generate a high enough correlation peak that satisfies the checks applied at the receiver.

M. Singh, et al., *Security Analysis of IEEE 802.15.4z/HRP UWB Time-of-Flight Distance Measurement,* PROCEEDINGS OF THE 14TH ACM CONFERENCE ON SECURITY AND PRIVACY IN WIRELESS AND MOBILE NETWORKS at 4 (June 28, 2021).

164. One or more of the Samsung '382 Products comprise a multichannel pseudorandom noise sequence mapping coupled to a digital lowpass finite impulse response shaping filter.

Specifically, the Samsung '382 Products use a pulse shaper to ensure compliance to the specified transmit mask and avoid distortion of other channels.

> In order to match the UWB signal to the 500 MHz bandwidth of [Ieee15], the pulse shape needs to be chosen carefully to ensure compliance to the [Ieee15] specified transmit spectrum mask and avoid distortion of adjacent channels. Additionally, stringent regulatory transmit limits must be respected. Figure 2 shows the [Ieee15] Root Raised Cosine (RRC) HRP UWB reference pulse with a center frequency that corresponds to channel 9, as well as an upconverted 8th order Butterworth low pass pulse with a -3 dB bandwidth of 500 MHz and a center frequency that corresponds to channel 5. Both of these pulses would meet the requirements specified in [Ieee15] to be used for IR-UWB radios.

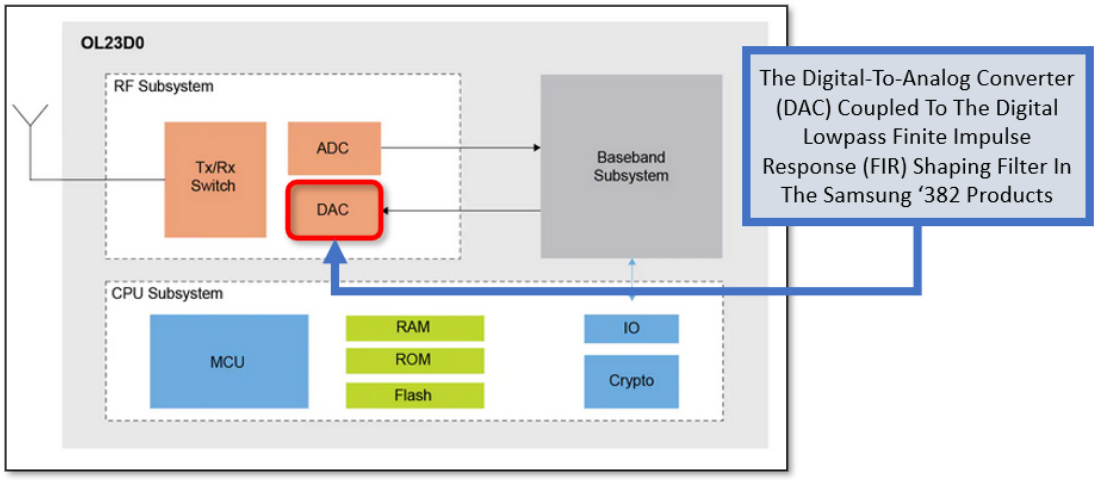
Frank Leong Hans-Juergen Pirch, *Introduction to Impulse Radio UWB Seamless Access Systems*, FIRA WHITE PAPER at 3 (2020) (emphasis added)

165. Further, the Samsung '382 Products use the multichannel PN sequence mapping to ensure compliance with the IEEE 802.15.4z standard.

> In other words, some systematic redundancy is added into the data in order to recover the correct data at the receiver in the presence of errors. Then, the coded data is mapped onto specific symbols for modulation purposes. As an example, the coded data can be mapped onto binary phase shift keying (BPSK) symbols, which take values from the set $\{-1,+1\}$.

Sinan Gezici and H. Vincent Poor, *Position Estimation via Ultra-Wideband Signals,* PROCEEDINGS OF THE IEEE 97.2 at 25 (2009).

166. One or more of the Samsung '382 Products comprise a digital lowpass finite impulse response shaping filter coupled to a digital-to-analog converter. For example, the Samsung '382 Products include an NXP Trimension SR100T UWB chipset. NXP Trimension chipsets such as the SR100T UWB chipset contains a digital to analog converter that is connected to a digital lowpass FIR filter.



Trimension UWB Chipset (OL23D0): Fully Customizable UWB Controller for IoT Webpage, NXP WEBSITE (last visited May 2022), *available at*: https://www.nxp.com/products/wireless/secure-ultra-wideband-uwb (annotation added).

167. One or more of the Samsung '382 Products contain a multichannel pseudorandom noise sequence mapping wherein two or more I delay units are coupled to two or more down sampling units followed by two or more Exclusive OR (XOR) units in parallel and said two or more XOR units are connected to a pseudorandom noise sequence look-up table.

Table 15-1 and Table 15-2 show how the PHR field, $H_0 - H_{18}$, PHY Payload field, $D_0 - D_{N-1}$, and Tail field, $T_0 - T_1$, are mapped onto the symbols. In these tables, the polarity bit column operation is an XOR. The tables also show when the transition from the header bit rate to the data bit rate takes place. Note that the delay line of the convolutional code is initialized to zero. For this reason, the position bit of Symbol 0 shall always be zero..

Table 15-1—Mapping of PHR field bits, PHY Payload field bits, and Tail field bits onto symbols with Viterbi rate 0.5

Symbol #	Input data	Position bit	Polarity bit	
0	H_0	0	H_0	21 symbols of PHY header at 850 kb/s or 110 kb/s
1	H_1	H_0	H_1	
2	H_2	H_1	$H_0 \oplus H_2$	
3	H_3	H_2	$H_1 \oplus H_3$	
...	...	...	...	
16	H_{16}	H_{15}	$H_{14} \oplus H_{16}$	
17	H_{17}	H_{16}	$H_{15} \oplus H_{17}$	
18	H_{18}	H_{17}	$H_{16} \oplus H_{18}$	
19	D_0	H_{18}	$H_{17} \oplus D_0$	
20	D_1	D_0	$H_{18} \oplus D_1$	
21	D_2	D_1	$D_0 \oplus D_2$	N symbols of data at data rate, e.g., 6.8 Mb/s
...	...	...	...	
N+17	D_{N-2}	D_{N-3}	$D_{N-4} \oplus D_{N-2}$	
N+18	D_{N-1}	D_{N-2}	$D_{N-3} \oplus D_{N-1}$	
N+19	T_0	D_{N-1}	$D_{N-2} \oplus T_0$	
N+20	T_1	T_0	$D_{N-1} \oplus T_1$	

IEEE STANDARD FOR LOW-RATE WIRELESS NETWORKS 802.15.4-2020 § 15.2.2 (2020) (emphasis added).

168. Samsung has directly infringed and continues to directly infringe the '382 patent by, among other things, making, using, offering for sale, and/or selling technology for a multichannel modulation Ultra-Wideband (UWB) communication transceiver, including but not limited to the Samsung '382 Products.

169. The Samsung '382 Products are available to businesses and individuals throughout the United States.

170. The Samsung '382 Products are provided to businesses and individuals located in the Eastern District of Texas.

171. By making, using, testing, offering for sale, and/or selling products and services for a multichannel modulation Ultra-Wideband (UWB) communication transceiver, including but not limited to the Samsung '382 Products, Samsung has injured Plaintiff and is liable to Plaintiff for directly infringing one or more claims of the '382 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

172. Samsung also indirectly infringes the '382 patent by actively inducing infringement under 35 U.S.C. § 271(b).

173. Samsung has had knowledge of the '382 patent since at least service of this Complaint or shortly thereafter, and Samsung knew of the '382 patent and knew of its infringement, including by way of this lawsuit.

174. Samsung intended to induce patent infringement by third-party customers and users of the Samsung '382 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '382 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '382 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '382 Products that have the capability of operating in a manner that infringe one or more of the claims of the '382 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '382 Products to utilize

the products in a manner that directly infringe one or more claims of the '382 patent.[13] By providing instruction and training to customers and end-users on how to use the Samsung '382 Products in a manner that directly infringes one or more claims of the '382 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '382 patent. Samsung engaged in such inducement to promote the sales of the Samsung '382 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '382 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '382 patent, knowing that such use constitutes infringement of the '382 patent.

175. The '382 patent is well-known within the industry as demonstrated by multiple citations to the '382 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '382 patent without paying a reasonable royalty. Samsung is infringing the '382 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

[13] *See, e.g., Samsung Galaxy S21 5G | S21+5g | S21 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Unfold A World Of Possibilities – Samsung Galaxy Z Fold3 5G Datasheet*, SAMSUNG DOCUMENTATION (2021); *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G User Manual*, SAMSUNG DOCUMENTATION (2021); *Samsung S22 Ultra Official Unboxing,* SAMSUNG YOUTUBE CHANNEL (February 24, 2022), *available at*: https://www.youtube.com/watch?v=uF1KwScZI6I; *Samsung Galaxy S21 5G, Galaxy S21+ 5G, Galaxy S21 Ultra 5G Quick Reference Guide*, SAMSUNG DOCUMENTATION (2021); *Introducing Galaxy S21 FE 5G*, SAMSUNG YOUTUBE CHANNEL (January 24, 2022), *available at*: https://www.youtube.com/watch?v=kdzpVHL3oyg; *Samsung Galaxy Z Fold2 5G Usual Manual,* SAMSUNG DOCUMENTATION (2022); *Samsung The Power To Work – Galaxy Note20 5G and Note20 Ultra 5G Datasheet*, SAMSUNG DOCUMENTATION (2020); and *Samsung Galaxy Note20 5G and Galaxy Note20 Ultra 5G Quick Reference Guide,* SAMSUNG DOCUMENTATION (2020).

176. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '382 patent.

177. As a result of Samsung's infringement of the '382 patent, Plaintiff has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

PRAYER FOR RELIEF

WHEREFORE, Plaintiff MIMO Research, LLC respectfully requests that this Court enter:

A. A judgment in favor of Plaintiff that Samsung has infringed, either literally and/or under the doctrine of equivalents, the '854, '716, '646, '057, and '382 patents;

B. An award of damages resulting from Samsung's acts of infringement in accordance with 35 U.S.C. § 284;

C. A judgment and order finding that Samsung's infringement was willful, wanton, malicious, bad-faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate within the meaning of 35 U.S.C. § 284 and awarding to Plaintiff enhanced damages.

D. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Plaintiff reasonable attorneys' fees against Samsung.

E. Any and all other relief to which Plaintiff may show themselves to be entitled.

JURY TRIAL DEMANDED

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Plaintiff MIMO Research, LLC requests a trial by jury of any issues so triable by right.

Dated: June 10, 2022

Respectfully submitted,

/s/ *Daniel P. Hipskind*

Dorian S. Berger (CA SB No. 264424)
Daniel P. Hipskind (CA SB No. 266763)
Erin E. McCracken (CA SB No. 244523)
BERGER & HIPSKIND LLP
9538 Brighton Way, Ste. 320
Beverly Hills, CA 90210
Telephone: 323-886-3430
Facsimile: 323-978-5508
E-mail: dsb@bergerhipskind.com
E-mail: dph@bergerhipskind.com
E-mail: eem@bergerhipskind.com

Elizabeth L. DeRieux
State Bar No. 05770585
Capshaw DeRieux, LLP
114 E. Commerce Ave.
Gladewater, TX 75647
Telephone: 903-845-5770
E-mail: ederieux@capshawlaw.com

Attorneys for MIMO Research, LLC